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Palæontologia Indica,

BEING

FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING THE PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

PUBLISHED BY ORDER OF THE GOVERNMENT OF INDIA.

Series XV.

Vol. V, Memoir No. 2.

THE FAUNA OF THE HIMALAYAN MUSCHELKALK.

PLATES I TO XVII.

By
CARL DIENER, Ph. D.,
Professor of Palæontology at the University of Vienna.

CALCUTTA:
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Jas. Perrin Smith

Palæontologia Indica.

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THE FAUNA OF THE HIMALAYAN MUSCHELKALK.

BY
CARL DIENER, PH.D.,
PROFESSOR OF PALÆONTOLOGY AT THE UNIVERSITY OF VIENNA.

INTRODUCTION.

There is no stage of the Indian Trias richer in fossils than the Muschelkalk of the Himálayas.

The age of the fauna of this horizon has been interpreted correctly by Oppel, F. von Hauer and Beyrich. A complete description of all the rich materials of Cephalopoda, collected by the brothers von Schlagintweit, Stoliczka, Griesbach and myself, was published in 1895 in Vol. II, Pt. 2 of this series of the Palæontologia Indica. It was supplemented by a very careful description of the small number of Brachiopoda and Lamellibranchiata by the late Dr. A. Bittner in 1899 in Vol. III, Pt. 2 of the present series.

After those two publications had been issued, large collections of fossils from the Muschelkalk of the Himálayas were obtained by Hayden and A. von Krafft in Spiti (1898-1900), by T. D. La Touche in the upper Lissar valley (1899) and by F. H. Smith in Byans (1899). Among those materials only the Cephalopoda collected in the year 1898 in Spiti by Hayden were examined by A. von Krafft and the result of this examination was a short preliminary account, published in the general report of the Geological Survey of India for 1898-99, pp. 11-22.

A full account, with the description and figures of the new forms discovered since 1897, will be given in the present work. Such species as have been described in Vol. II, Pt. 2 of this series by myself, or in Vol. III, Pt. 2 by Bittner, will only be referred to in cases where new discoveries have succeeded in enlarging our knowledge. Thus, the present work may be considered as a sequel to the two above-mentioned publications in the Palæontologia Indica.

DESCRIPTION OF FOSSILS.

Class : **BRACHIOPODA.**

Genus : SPIRIFERINA d'Orb.

1. SPIRIFERINA STRACHEYI Salter. Pl. I, fig. 6.

1865. *Spiriferina Stracheyi* Salter, Palæontology of Niti, p. 72, Pl. IX, fig. 13.
1899. *Sp. Stracheyi* Bittner, Himál. Foss., Pal. Ind., ser. XV, Vol. III, Pt. 2, p. 18, Pl. IV, figs. 3-14.

This species, which is the commonest leading fossil of the main mass of the lower Muschelkalk in Spiti, Garhwal and Byans, is very largely represented in the collections of Hayden, A. v. Krafft and Smith. To the localities known to Bittner—Shalshal cliff (coll. Strachey and Diener), Lilang (coll. Stoliczka)—the following must be added: Bambanag cliff (coll. A. v. Krafft), W. of Lilang (coll. v. Krafft), N.-E. of Lilang (coll. v. Krafft), N.-W. of Muth (coll. Hayden), W. of Po (coll. A. v. Krafft), Kalapani (coll. Smith), Jolinka (coll. Smith), ridge between Dharma and Lissar valleys (coll. La Touche).

Notwithstanding the large materials available to me for examination, I can add but very little to the excellent description of the species given by the late Dr. Bittner. The most remarkable character of adult individuals, namely, the presence of wing-like expansions of the hinge-line, is very strongly developed in some of my specimens, especially in those from the Muschelkalk of Lilang. The figured example, which is particularly wide, surpasses in this respect all the specimens known to Bittner and recalls most vividly *Spiriferina alata* Schloth. from the Permian rocks of England as illustrated by King. In this example a width of the ventral valve of 46 mm. corresponds to a length of 12·5 mm.

2. SPIRIFERINA (MENTZELIA) KOEVESKALLIENSIS Suess.

1873. *Spiriferina Koeveskalliensis* Suess, in Boeckh, Geologische Verhältnisse des südl. Bakony, p. 175, Pl. XI, figs. 22, 23.
1899. *Sp. Koeveskalliensis* Bittner, Himál. Foss., Vol. III, Pt. 2, p. 21, Pl. IV, figs. 15, 16. For a complete list of synonyms the reader is referred to this memoir.

Of this species, which has been considered as identical with *Spiriferina spitiensis* Stol. by Bittner, a small number of examples were collected in the Muschelkalk near Muth and N.N.W. of Kágá (Spiti) by Hayden.

There is only a single individual exhibiting the flat, compressed shape of the variety *microrhyncha*. All the rest of the specimens are strongly inflated, and provided with a remarkably thick and strongly incurved beak, recalling Stoliczka's type-specimen of the variety *spitiensis*. One ventral valve from Kágá is, in its size and outlines, exactly like ***Mentzelia Mentzelii var. judicarica*** Bittner (Brachiopoden der Alpinen Trias, Abhandl. K. K. Geol. Reichsanst., XIV, p. 24, Taf. XXXIV, fig. 26), from which it is distinguished only by the striation of its shell.

The more abundant European types of *Sp. Koeveskalliensis* seem to be rather rare in the Indian Muschelkalk, where the species is chiefly represented by the *var. spitiensis*.

3. SPIRIFERINA (MENTZELIA) MENTZELII Dunk. Pl. I, fig. 3.

1851. *Spiriferina Mentzelii* Dunken, Palæontographica I, 1, p. 287, Tab. XXXIV, figs. 17-19.
1890. *Sp.* (*Mentzelia*) *Mentzelii* Bittner, Brachiopoden der Alpinen Trias, Abhandl. K. K. Geol. Reichsanst. XIV, p. 22, Taf. XXXIV, figs. 1-28. For a complete list of synonyms refer to this memoir.

In the Muschelkalk of Muth, Spiti, there occurs together with *Spiriferina Koeveskalliensis* a smooth *Mentzelia*, which cannot be distinguished from some varieties of the common European *M. Mentzelii*.

It is especially the variety *illyrica* Bittner (l. c. Taf. XXXIV, fig. 28), to which the only specimen available for examination is most nearly allied. It is provided with a large, open area and with a strongly developed mesial sinus, to which a distinctly defined broad and low mesial fold corresponds in the dorsal valve. The beak is not perfectly straight, but slightly incurved. The sinus is flat, low, and accompanied by sharply-marked borders in the apical region.

There is also a strong relationship between this specimen and the variety *baconica* Bittner (l. c. Taf. XXXIV, fig. 27). They agree very closely in their dimensions, in the strong beak, towering above a broad area, and in the character of the front line. Rudimentary plications in the lateral parts of both valves are not entirely absent in my Himálayan example, but considerably less distinctly developed than in the *var. baconica*.

No other specimen being available for examination, I have not been able to study its internal characters.

The measurements of this specimen are as follow:—

Entire length of the shell	20	mm.
„ width „ „ „	21	„
Length of the dorsal valve	15·5	„
Thickness of both valves	12	„

Genus: SPIRIGERA d'Orb.

I. SPIRIGERA STOLICZKAI Bittner.

1899. *Spirigera Stoliczkai* Bittner, Himál. Fossils, Palæont. Ind., ser. XV, Vol. III, Pt. 2, p. 23, Pl. III, figs. 1-17.

To the localities from which this species has been quoted by Bittner, the following must be added: Kalapani (coll. Smith), Jolinka, Byans (coll. Smith), Bambanag cliff (coll. A. v. Krafft), Kágá, Spiti (coll. Hayden), Muth (coll. Hayden and A. v. Krafft), N.N.W. of Po (coll. A. v. Krafft).

I have to add but very little to Bittner's excellent description of this species. In the Muschelkalk of Kalapani it seems to be rather richly represented, but by small-sized specimens only. I have scarcely any doubt that they may be assigned with full certainty to *Sp. Stoliczkai*, since they agree with the types from the Shalshal cliff in all their characters except their small dimensions. Near Jolinka a small number of normal-sized examples was collected by Smith.

A remarkable case of convergence must be noticed between *Sp. Stoliczkai* and *Dielasma Himálayanum* Bittner. In the Muschelkalk of Spiti types of the present species are occasionally met with, which are distinguished from the normal type by their very flat valves, by their slightly elongated shape and by the absence, or only rudimentary development, of a mesial sinus in the ventral valve. Such types are very similar to some forms of *Dielasma Himálayanum*, another most abundant species in the horizon of *Spiriferina Stracheyi*. To their outward similarity is added a strikingly similar structure of the beak, which in both species is provided with strong dental plates, extending rather far upward into the visceral region. It is only by grinding off the front portion of such types, that their relation to *Sp. Stoliczkai* can be proved with full certainty.

Genus: RETZIA King.

RETZIA (?) HIMAICA Bittner.

1899. *Retzia himaica* Bittner, Himálayan Fossils, Pal. Ind., ser. XV, Vol. III, Pt. 2, p. 22, Pl. IV, figs. 17, 18.

This interesting species is represented by six specimens in A. v. Krafft's collections from the lower Muschelkalk (horizon of *Rhynchonella Griesbachi*) of the Bambanag cliff. They are of the same size as my type-specimens from the Shalshal cliff and are distinguished from all other Triassic *Retziæ* by the absence of any remarkably developed median rib in the dorsal valve and by the very low and rather indistinct area. As has been remarked by Bittner (Brachiopoden der Alpinen Trias, Abhandl. K. K. Geol. Reichsanst., 1890, XIV, p. 296) all Triassic representatives of the genus *Retzia* (in a wider sense) are provided with a small, sharply-bordered, triangular area. This character is equally well developed in the Carboniferous group of *Retzia radialis* Phill. and *R. ulotrix* de Kon., which have been united in the genus *Hustedia* by Hall and Clarke (Introduction to the Study of the Genera of Palæozoic Brachiopoda, Pal. of New York, Vol. VIII, Pt. 2, p. 122). It is not probable that our Himálayan species is congeneric with *Hustedia radialis*. Nor can it remain in the genus *Retzia*, if the latter is taken in a narrower circumscription corresponding to King's original type *Terebratula Adrieni* Vern.

Retzia (?) *himaica* is probably a type of distinct generic structure, but the determination of the critical features in the genera allied to *Retzia* is attended with peculiar difficulties. The examples available to me are not sufficiently well preserved for the study of their complicated internal structure, although I have succeeded in establishing the presence of spiral cones.

Genus: DIELASMA King.

DIELASMA HIMALAYANUM Bittner.

1899. *Terebratula* (*Dielasma*) *Himálayana* Bittner, Himál. Foss., Vol. III, Pt. 2, p. 25, Pl. V, figs. 1-8, 10, 11.

Broader and narrower forms of this common species from the horizon of *Spiriferina Stracheyi* have been collected in the Muschelkalk of Kalapani by Smith, at Lilang, Kágá and N.-W. of Po by A. v. Krafft, at Kágá, Muth (Spiti) and in the Thanam valley (Bashahr) by Hayden, and on the ridge between Dharma and Lissar valleys by La Touche.

On the majority of casts the very strong dental plates of the ventral and the median septum of the dorsal valve are very distinctly developed. There are, however, exceptional specimens in which only faint traces of dental plates have been noticed and which consequently resemble the well-known Muschelkalk species *Cœnothyris vulgaris* Schloth. more closely than the typical forms of *D. Himálayanum.*

Genus: CŒNOTHYRIS Douvillé.

CŒNOTHYRIS VULGARIS Schloth. Pl. I, figs. 4, 5.

1823. *Terebratulites vulgaris* Schlotheim, Nachtraege zur Petrifactenkunde, Tab. XXXVII, figs. 5-9.

1890. T. (*Cœnothyris*) *vulgaris* Bittner, Brachiopoden der Alpinen Trias l. c., p. 5. For a complete list of synonyms *vide* this memoir.

1899. *T.* (*C.*) *cf. vulgaris* Bittner, Himál. Foss., Vol. III, Pt. 2, p. 28, Pl. V, fig. 14.

Only a single specimen from Lilang was known to Bittner, which he considered referable with some probability to this most abundant species of the European Muschelkalk. From the upper Muschelkalk of Kágá, Spiti, two specimens (coll. Hayden) are before me, which I cannot separate from *Cœnothyris vulgaris.* They are absolutely identical with typical specimens of this species from the Muschelkalk of Judicaria in the collections of the University and of the K. K. Geol. Reichsanstalt.

Externally, dental plates in the beak of the ventral valve are not visible. In order to make sure of their absence, I have made a section through the cardinal region of the larger specimen. Dental plates are not at all developed, just as in full-grown individuals of *C. vulgaris.* The median septum of the dorsal valve and the two lateral hinge-plates supporting the dental sockets are very strongly marked in my smaller example.

Both specimens belong to the asinuated form of *C. vulgaris,* having no indication of a frontal wave.

The measurements of those two specimens are as follow:—

Dimensions.

Entire length } of the shell	30	mm.	20	mm.
„ breadth } of the shell	21·5	„	19	„
Length of the dorsal valve	25	„	18	„
Thickness of both valves	17·5	„	12·5	„

Genus : RHYNCHONELLA Fisch.

1. RHYNCHONELLA GRIESBACHI Bittn.

1899. *Rhynchonella Griesbachi* Bittner, Himálayan Foss., Vol. III, Pt. 2, p. 12, Pl. II, figs. 1-7.

Numerous examples of this characteristic species of the group of *Rhynchonella trinodosi* Bittner were collected from the Muschelkalk of Kalapani by Smith. Two specimens were obtained from the lower Muschelkalk of the Bambanag cliff by A. v. Krafft.

2. RHYNCHONELLA cf. DIENERI Bittner.

1899. *Rhynchonella Dieneri* Bittner, Himál. Foss., Vol. III, Pt. 2, p. 14, Pl. II, figs. 8, 9.

Two specimens from the Muschelkalk of Lilang, which were collected by the late A. von Krafft together with *Spiriferina Stracheyi*, differ from *Rhynchonella Griesbachi* by their larger size, greater width and shallower shape. Thus, in their external characters my examples agree rather closely with *Rh. Dieneri*, but the dorsal valve of the more complete specimen exhibits a very strongly marked median septum. As the presence of a strongly developed median septum is regarded by Bittner as one of the distinguishing characters of *Rh. Griesbachi*, I dare not venture on a direct identification of my specimens from Lilang with *Rh. Dieneri*, notwithstanding their external resemblance.

A third specimen with numerous plications in the sinus and in the corresponding frontal wave was collected from the Muschelkalk of Kágá by A. v. Krafft.

3. RHYNCHONELLA MUTABILIS Stoliczka.

1865. *Rhynchonella mutabilis* Stoliczka, Memoirs Geol. Surv. of India, Vol. V, Pt. 1, p. 40, Pl. III, figs. 5-9.
1899. *Rh. mutabilis* Bittner, Himál. Foss., Vol. III, Pt. 2, p. 15, Pl. II, figs. 11-13.

That *Rhynchonella mutabilis* is a Muschelkalk species and does not occur in the upper Trias, as had been suggested by Stoliczka, has been proved by the discovery of numerous specimens in the Muschelkalk at Lilang—the place from which Stoliczka's type-specimens have been recorded—also N.N.W. of Muth, west of Po and at the Shalshal cliff, where a large number of examples were collected from the horizon of *Spiriferina Stracheyi* by A. v. Krafft.

4. RHYNCHONELLA TRINODOSI Bittner. Pl. I, figs. 1, 2.

1890. *Rhynchonella trinodosi* Bittner, Brachiopoden der Alpinen Trias, Abhandl. K. K. Geol. Reichsanst., XIV, p. 13, Taf. XXXVII, figs. 17-35.
1899. *Rh. cf. trinodosi* Bittner, Himál. Foss., Vol. III, Pt. 2, p. 14, Pl. II, fig. 10.

There are two specimens of this common European species in Smith's collection from Kalapani, both of them agreeing so closely with some of the Alpine types described and illustrated by Bittner, that I cannot separate them. Both specimens are of large size and provided with strongly-inflated valves. The frontal lobe is less broad than in the variety *latelinguata* Bittn., and has two folds in the smaller, but only one in the larger, of my two examples. The depressions which separate the median elevation of the dorsal valve from the lateral parts, are sharply marked and reach higher upwards into the visceral portion of the shell than in *Rh. Griesbachi.* The median septum of the dorsal valve is also shorter than in the latter species, which otherwise is very nearly allied to *Rh. trinodosi.*

Dimensions.—The measurements of the smaller but more complete specimen are as follow :—

Length of the shell	13	mm.
" " " dorsal valve	12	"
Breadth of the shell	13	"
Thickness of both valves	8·5	"

Class : LAMELLIBRANCHIATA.

Among the fossils of the Himálayan Muschelkalk collected by Hayden, La Touche, Smith and A. v. Krafft, there is no more difficult group than the Lamellibranchiata. They are neither richly represented in the Himálayan collection nor are the specimens sufficiently well preserved to allow an exact observation of their specific characters. The number of forms worthy of specific description is therefore very small. In many cases I have not succeeded in identifying the genus with certainty, even in species of which a considerable number of examples has been available for examination, as in *Cardiomorpha* (?) *Haydeni.* This will, I hope, explain my reasons for deeming it preferable to leave undescribed such materials as by their fragmentary state of preservation are rendered absolutely unfit for determination.

Genus : POSIDONOMYA Bronn.

1. POSIDONOMYA cf. BOSNIACA Bittner. Pl. I, figs. 8, 9.

1902. *Posidonomya bosniaca* Bittner, Brachiopoden und Lamellibranchiaten aus der Trias von Bosnien, Dalmatien und Venetien. Jahrb. K. K. Geol. Reichsanst., LII, p. 595, fig. 10.

From the Muschelkalk of the ridge between the Dharma and Lissar valleys (coll. La Touche) numerous fragments of right and left valves are before me, which undoubtedly belong to a species of *Posidonomya,* distinguished by almost equal length and height. The hinge-line is short. The pointed and distinctly prominent apex is roughly median in its position. The shell is but slightly inequilateral. The complete absence of any wings excludes its identification with *Pseudomonotis* or its allies. Both valves are equally and moderately vaulted.

The ornamentation consists of concentric ridges occurring at regular intervals and crossed by very delicate radial striæ. The radiating sculpture is only noticed in perfectly well-preserved specimens.

There are only two European species of *Posidonomya* of Triassic age, which can put in a claim for a closer comparison with the present one. These are *P. bosniaca* Bittner from the Muschelkalk of Cevljanovic and *P. alta* v. Mojsisovics (Jahrb. K. K. Geol. Reichsanst., 1873, p. 438, Taf. XIV, fig. 6) from the Buchenstein beds of the Bakony in Hungary. All the other Alpine species of *Posidonomya* are considerably longer than high.

P. alta is of a nearly rectangular outline and of very small dimensions (7–8 mm.). My Himálayan examples are considerably larger (32–30 mm.) and agree both in their outlines and ornamentation very closely with *Pos. bosniaca*. I have consequently placed them provisionally under *P. cf. bosniaca*, but without insisting on a direct identity between the European and Himálayan species.

2. Posidonomya sp. ind.

From the same locality two fragments of a second species of *Posidonomya* were collected by T. D. La Touche. They agree with *P. bosniaca* in their concentric ornamentation, but differ by their greater length and by their strongly inequilateral shape. The two fragments are not sufficiently well preserved to establish their specific characters.

3. Posidonomya sp. ind. aff. pannonica Mojs. Pl. I, fig. 7.

A large *Posidonomya*, of which several imperfectly-preserved specimens—casts of right and left valves—were collected by Hayden from the Muschelkalk of Muth, Spiti. The specimen illustrated in fig. 7 deserves special mention on account of its being composed of both valves, which are firmly attached to each other. My materials being insufficiently preserved, I should not like to introduce a new specific denomination for this form, which in some of its features agrees with *P. pannonica* v. Mojsisovics (Ueber einige Triasversteinerungen aus den Südalpen, Jahrb. K. K. Geol. Reichsanst., 1873, XXIII, p. 437, Taf. XIV, fig. 5) from the Buchenstein beds of the Bakony. It is, however, of considerably larger size, its hinge-line is shorter and its posterior margin is elongated obliquely, its junction with the ventral margin forming a sharply rounded-off angle. There is no difference in the amount of inflation between the two valves, both of them being very moderately vaulted. The small apex scarcely projects beyond the straight hinge-line.

The presence of very numerous concentric lamellæ and of a delicate concentric striation in the interlamellar spaces imparts to the sculpture an external appearance very like that of *P. pannonica*.

This is certainly a new species, distinguished from the congeneric Alpine forms by its large dimensions and different outlines. In the common *Pos. Wengensis* Wissmann (Graf Münster, Beitræge zur Geognosie und Petrefaktenkunde des sudöstlichen Tirols, p. 23, Taf. XVI, fig. 12) the hinge-line is considerably longer and the posterior margin regularly rounded, whereas *P. idriana* Mojs. (l. c. p. 437, Taf. XIV, fig. 4) is of a nearly circular shape.

Genus: LIMA Deshayes.

1. LIMA sp. ind. aff. LINEATA Deshayes.

Fragments of both valves of a very large *Lima* from the upper Muschelkalk of Kágá, Spiti (coll. Hayden). In one of my fragments only a few traces of the test have been preserved. They are situated in the vicinity of the lateral margins, and covered with delicate, radiating striæ, which are crossed by irregularly-set, concentric lines of growth. A fragment of the test in the visceral portion of this specimen exhibits traces of broad and flat ribs, recalling the ornamentation of *Lima lineata* from the German Muschelkalk, as illustrated by Goldfuss (*Petrefacta Germaniæ*, Vol. II, p. 75, Pl. C, fig. 3).

My fragments—imperfect and strongly-weathered casts, unfit for specific determination—belong to a species of very large size, rivalling in dimensions the well-known *Lima gigantea* Desh. from the Lias of Wurtemberg.

2. LIMA sp. ind.

From the Muschelkalk between the Dharma and Lissar valleys (coll. La Touche) several imperfectly-preserved valves of a small *Lima* are before me. The shell is considerably inflated and with a steep anterior slope. The wings have been broken off. The surface is covered with numerous radiating ribs.

Limæ of such indifferent form are widely distributed throughout Triassic and Jurassic horizons. It is not possible to identify the Himálayan examples with any European form.

Genus: GERVILLEIA Defr.

GERVILLEIA sp. ind.

A fragmentary left valve of a *Gervilleia* (?) from the Muschelkalk between the Lissar and Dharma valleys, recalls *G. angusta* Goldf. (*vide* Bittner, Lamellibranchiaten von St. Cassian, Abhandl. K. K. Geol. Reichsanst. XVIII, p. 86, Taf. IX, figs. 7-10, 12, 16, 18). Its posterior margin is, however, less strongly elongated. The hinge-line is very short, with a nearly terminal apex.

In its shape this species has also some similarity to *G. bosniaca* Kittl. (Jahrb. K. K. Geol. Reichsanst., LIII, 1903, p. 709, Taf. XXIII, fig. 8), but is of much larger size and not provided with strong lamellæ of growth.

From the same locality a left valve of a large *Gervilleia* is before me, which in its general shape and outlines recalls *Avicula Tofanæ* Bittner (l. c. p. 71, Taf.

VIII, figs. 9-11). But the total absence of an anterior wing makes its reference to *Gervilleia* more probable, although I have not been able to observe the ligamental furrows.

Genus: PLEUROPHORUS King.

PLEUROPHORUS nov. sp. ind. Pl. I, fig. 12.

The only specimen of an equivalve shell from the lower Muschelkalk of Lilang (coll. Krafft) recalls in its external characters some of the Permian species of *Pleurophorus* King. It is considerably larger than high, of trapezoidal outlines, with rounded corners, narrowed anteriorly, expanded posteriorly. Apex corresponding to the anterior termination of the straight hinge-line and strongly incurved. Hinge-line equalling two-thirds of the entire length of the shell. Ventral margin with a faint sinuosity near the middle, passing into the posterior margin in a gracefully rounded curve. Posterior margin almost circular, meeting the hinge-line in a sharp angle. The posterior part is not separated from the visceral portion of the shell by a distinct keel. Under the umbonal slopes a small concavity extends anteriorly from the base of the beaks towards the ventral margin. The small and lanceolate area is bordered along its exterior side by a sharp rib There is no distinct lunula present.

The surface of both valves has suffered considerably from weathering. No traces of the delicate ornamentation have been left, there being merely a few indistinct radiating ridges on the posterior wing.

The cardinal region not being accessible for examination, the systematic position of this shell must remain uncertain. Notwithstanding its external similarity to *Pleurophorus*, the possibility of its belonging to the genus *Myoconcha* cannot be excluded. In this respect it might perhaps be compared with the Triassic species from St. Cassian, which has been described as *Myophoria Blainvillei* by A. v. Klipstein, but will have to find its proper systematic position near either *Pleurophorus* or *Myoconcha* (Bittner, Lamellibranchiaten von St. Cassian, l. c. p. 41, Taf. IV, fig. 4).

Genus: CARDIOMORPHA de Kon.

CARDIOMORPHA (?) HAYDENI nov. sp. Pl. I, figs. 10, 11.

A few specimens from the Muschelkalk of Muth (coll. Hayden) recall in their external characters such Permian bivalves as have been united with *Astarte*, *Cardiomorpha*, *Edmondia*, etc., by various authors.

The two valves are always firmly attached to each other. The shell is slightly inequivalve, the right valve being the larger; but the difference in their size is subject to some variation. The outline is longitudinally subovate, with very moderately curved ventral and dorsal margins. Anterior margin subtruncate, posterior margin narrowly rounded. Beak situated near the anterior end of the hinge-line, strongly incurved, declining abruptly towards the anterior side, and enclosing a small lunula in front, without sharply defined borders.

Surface of both valves covered with numerous, regular concentric lines of growth. I have not succeeded in discovering any traces of the hinge-apparatus.

This species is one of the commoner bivalves of the Muschelkalk of Spiti and is distinguished by its rather remarkable sculpture. I have, therefore, considered it worthy of a special description and of a proper specific name. Its generic position is, however, absolutely uncertain, none of its internal characters being known to me. Its external resemblance to *Edmondia* and *Cardiomorpha* has induced me to place it provisionally in the latter genus, *Edmondia* being restricted to such species as are provided with gaping valves (Dall in Zittel's Textbook of Palæontology, English edition, p. 362).

Among the Lamellibranchiata of the Alpine Trias there is especially *Anodontophora Telleri* Bittner (Lamellibranchiaten der Trias von Hudiklanec bei Loitsch in Krain, Jahrb. K. K. Geol. Reichsanst., LI, 1901, p. 231, Taf. VII, figs. 5-7) which may put in a claim for a closer comparison with the present species. It differs, however, by the presence of a diagonal ridge running from the apex towards the rounded-off corner in which the ventral and posterior margins unite. Nor has the examination of my Himálayan examples led to the discovery of any of the internal characters which are so characteristic of the Triassic genus *Anodontophora.*

From the Bosnian Muschelkalk of Han Bulog the genus *Cardiomorpha* has been quoted with some reserve by Kittl (Geologie der Umgebung von Sarajevo, Jahrb. K. K. Geol. Reichsanst., LIII, 1903, p. 716). There is, however, no affinity between the Bosnian species attributed to *Cardiomorpha* and our *C. Haydeni* from Spiti.

Class: GASTEROPODA.

(By Friedrich Blaschke.)[1]

The following descriptions of some species of *Gasteropoda* from the Muschelkalk of the Himálayas are based on rather scanty material, which is neither rich in species nor in individuals. The state of preservation of the fossils, which are mostly casts in a black compact or marly limestone, with only very few traces of the shelly substance, is rather unsatisfactory. Nevertheless, a small number of interesting and well characterised forms could be picked out, which add considerably to our knowledge of the Himálayan Muschelkalk fauna of *Glossophora,* hitherto unknown.

A comparison of those forms with European species shows that nearly allied types are represented in the Alpine and Indian zoo-geographical regions. It must, however, be borne in mind, that no exhaustive description of the *Gasteropoda* of the Alpine Muschelkalk has as yet been published. Tornquist's notes on the fauna of Recoaro and Kittl's monograph of the fauna of the Veszprim-Mergel in Hungary are the only modern papers dealing with local faunæ of *Glossophora* of the normal Alpine Muschelkalk, not developed in the facies of the Hallstatt limestone.

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[1] The following description of the *Gasteropoda* is the work of Dr. Friedrich Blaschke, whose monograph of the Gasteropoda of the upper Triassic Pachycardia beds of the Seiser Alpe in Tyrol is well known to palæontologists; the part taken by Prof. Diener in the work was confined to revising and translating Dr. Blaschke's manuscript. *Dir., G. S. I.*

A comparison of the Himálayan specimens with the rich fauna of glossophora from the German Muschelkalk does not lead to an identification of any Indian species with European ones, the differences between them and their nearest European allies being considerable enough to forbid any attempt in this respect, apart from the uncertainty which is connected with any direct identification based on such scanty and poorly preserved materials.

The list of species here described, is as follows :—

1. *Pleurotomaria indica* nov. sp.
2. „ sp. ind. *A.*
3. „ sp. ind. *B.*
4. *Worthenia Dieneri* nov. sp.
5. „ *Dharmäensis* nov. sp.
6. „ *aff. Dharmāensis* Bl.
7. *Tectospira (?) gracilis* nov. sp.
8. *Omphaloptycha* sp. ind.
9. „ (?) nov. sp. ind.
10. *Pseudomelania* sp. ind.

To these must be added two undeterminable casts, one of them being doubtfully referable to *Promathildia.*

The most prominent feature in the character of this faunula is the predominance of *Pleurotomaria* and *Worthenia.* It is chiefly *Worthenia Dharmäensis,* together with some very nearly allied forms, which are represented in the Himálayan collections from a considerable number of localities and by more individuals than all the other species together. There is, on the whole, no type in the faunula which might not be expected to occur in a fauna of Triassic age. It is, moreover, conspicuous by the scanty development of *Pyramidellidæ* and by the total absence of *Neritopsidæ, Neritidæ* and of all types with Palæozoic affinities, such as *Bellerophon, Capulus* and *Euomphalus.*

Although the small number of specimens does not permit any definite conclusions, the remarkable predominance of types with very thin shells, such as *Pleurotomaria* and *Worthenia,* speaks strongly in favour of Muschelkalk sediments, which were deposited at some distance from the shore and at considerable depths.

In working out the descriptions of this faunula, the following papers have been chiefly consulted :—

1895. *J. Boehm*, Gastropoden der Marmolatakalke, Palæontographica, XLII.

1900. *E. Kittl*, Gastropoden aus der Trias des Bakonyer Waldes, Resultate der wissenschaftlichen Erforschung des Balatonsees. Palæontologischer Anhang zum ersten Teile des ersten Bandes.

1896. *E. Koken,* Gastropoden der Trias um Hallstatt, Abhandl. K. K. Geol. Reichsanst., XVII.

1898. *E. Koken*, Beitraege zur Kenntnis des suddeutschen Muschelkalkes, Abhandl. z. Geol. Specialkarte von Elsass-Lothringen, Neue Folge, Heft 2.

1900. *A. Tornquist*, Neue Beitraege zur Geologie und Palæontologie der Umgebung von Recoaro und Schio IV. Teil, Zeitschr. Deutsch. Geol. Ges. Bd. LII.

1901. *E. Picard*, Beitrag zur Kenntnis der Glossophoren der mitteldeutschen Trias, Jahrb. Kgl. preuss. Geol. Landesanst. Bd. XXII.

For further references the reader should consult my paper on the "Gastropodenfauna der Pachycardien. Tuffe der Seisser Alpe in Suedtirol" Beitraege zur Palæontologie und Geologie Oesterreich-Ungarns, etc. Bd. XVII.

Genus: PLEUROTOMARIA Defr.

PLEUROTOMARIA INDICA nov. sp. Pl. XIII, fig. 1.

The type-specimen of this species and a small number of examples nearly allied to it are referable to the genus *Pleurotomaria*. They are provided with globose whorls and with a distinct slit-band, which is situated below the middle of the height. Thus they differ from the representatives of the genus *Worthenia*, which I shall describe later on, and which are characterised by the presence of a slit-keel situated considerably higher than the middle line of the whorl.

Similar forms have been described by Koken among the Gasteropoda of the Triassic Hallstatt limestone and have been grouped with *Pleurotomaria*. I am following this learned author in leaving them in that genus.

The specimen illustrated in Pl. XIII, fig. 1, is the fragment of a large shell. It is the largest among my Indian materials of *Glossophora*. The last and the penultimate whorls have been partly preserved, but as casts only. The aperture and the shelly substance have been destroyed almost completely.

The spire was probably broad and high, conical, with strongly inflated whorls which were sharply separated by deep scales. The base of the body-whorl is somewhat flattened and marked off from the strongly convex external flank of the whorl by a blunt edge. On the external flank of the last whorl the cast of the slit-band is visible, bordered by two elevated keels. The apical portion of the whorl is also bordered by a blunt edge. It is curved with moderate convexity towards the suture, which is deepened. The last whorl projects by more than one-half of its diameter beyond the preceding one.

In the ornamentation of the last whorl well developed striæ of growth are rather prominent. They run backwards for some distance from the suture, are strongly curved, whilst ascending the lateral parts towards the slit-band, which they cross vertically and converge towards the base in perfectly straight lines. There is some probability of longitudinal striæ having also been present, as may be assumed from the presence of slight spiral elevations in the striæ of growth. To this pattern of ornamentation a very delicate system of parallel lines is added, which is most conspicuous on the apical portion of the whorl. These delicate lines run obliquely forwards across the striæ of growth, meeting them in an acute angle.

Of the sculpture of the penultimate whorl little more is known than what we may learn from an examination of some scanty fragments of the shelly substance near its external part (Pl. XIII, fig. 1*b*). This fragment, measuring 1 to 2 mm. in width, shows some delicate spiral lines crossed by a system of obliquely transverse striæ, below the blunt edge bordering the base of the preceding whorl. Then follows the slit-band, enclosed by prominent spiral edges and adorned with a regular crescent-shaped ornamentation. Outside the slit-band traces of a second more delicate band are noticed, which was also enclosed by longitudinal carinæ and covered with delicate grooves, but the sculpture of this band has been destroyed almost completely.

From the poor fragment of shelly substance the presence of a very complicated ornamentation in this species is evident; but the details of sculpture are, unfortunately, not accessible to examination.

The shell itself was extremely delicate, measuring barely 0·2 to 0·3 mm. in thickness.

Dimensions.

Height of the last whorl	22 mm.
" " " penultimate whorl	11 "

Locality.—Muth, Spiti, coll. Hayden.

PLEUROTOMARIA sp. ind. (A). Pl. XIII, fig. 2.

A specimen of smaller dimensions, represented by the fragment of a cast of the last whorl, exhibits the same measurements as the preceding species. The base is flattened and rather sharply separated from the external part. The edge forming a demarcation between the convex apical part and the similarly convex external part, is strongly obtuse.

The principal difference between this species and *Pleurotomaria indica* consists in the character of ornamentation. The cast scarcely exhibits anything at all of striæ of growth, which are so well marked in the preceding species. On the other hand, both the external and apical parts of the whorl are covered with strong longitudinal striæ. Seven are counted on the apical and six on the external part, three of them on either side of the prominent slit-band. In some places this spiral sculpture is crossed by delicate lines, which are turned forward below the slit-band and probably correspond to striæ of growth. Similar striæ have also been noticed on a very small fragment of the shell preserved on the base of the whorl, which is otherwise smooth.

The slit-band is bordered by two spiral keels. It is distinctly elevated above the general convexity of the external part and shows narrow vermiform grooves in addition to the system of striæ of growth. The shelly substance is as thin as *Pleurotomaria indica.*

Locality.—Kágá, Spiti, coll. Krafft.

PLEUROTOMARIA sp. ind. (B).

The third fragment of the last whorl of a large *Pleurotomaria* is also distinguished by its strong inflation, attaining its maximum extent below the middle of the height, which measures 12 mm. This point of maximum inflation is occupied by the slit-band, which is bordered by distinct spiral keels. Less distinctly developed longitudinal lines have been noticed above and below the slit-band.

The base of the whorl is incurved and strongly concave.

Locality.—Muth, Spiti, coll. Krafft.

Genus : Worthenia de Kon.

Worthenia Dieneri nov. sp. Pl. XII, fig. 6.

A specimen, which is more complete and better preserved than any among the scanty materials of Gasteropoda in the Himálayan collections, is, in all its characters, very nearly allied to such types as have been described and illustrated from the Muschelkalk of the Bakony in Hungary by Kittl (*Worthenia Loczyi*) and from the German Muschelkalk by Picard (*Worthenia lævis*, l. c. Pl. II, figs. 8-11). Similar types are also represented in the Triassic rocks of the Eastern Alps.

The shelly substance of the specimen illustrated being almost entirely preserved, a nearly complete diagnosis of the species can be given, the apical whorls and the aperture only remaining unknown. Four whorls are present, which increase rather rapidly in height. The strongly-projecting upper lateral keel and the following slit-keel separate the apical part of the whorl from the broad, band-shaped lateral excavation. From this lateral excavation the base of the whorl is also marked off very sharply by a third keel.

The apical part is roof-shaped. It is convex in the immediate vicinity of the deeply-incised suture, which coincides with the lateral excavation of the preceding whorl but unites with the carinate sinus in a concave curve. The last whorl is so steep that the sharp angle between the external part of the penultimate and the apical part of the last whorl is transformed into a concave plane. This change in the proportion of the whorls is quite gradual; in the spire they meet in a sharp angle, almost a right angle, but in the vicinity of the aperture the last whorl is drawn up along the suture of the penultimate one.

The whorls are covered with delicate spiral lines, which are densely crowded, eight lines being counted on the last whorl. The spiral lines are crossed by numerous striæ of growth which are turned backwards from the suture and cross the longitudinal keels in a vertical direction. Indistinct notches are formed along the edge of the topmost keel, which is situated next the suture.

The lateral band between the two elevated keels is flatly concave, excavated and asymmetrical, the upper part being slightly higher. The region of deepest depression in the whorl is marked by a smooth band, which is bordered by strong longitudinal keels. Such keels are more numerous in the upper portion extending towards the first lateral carina, and are more faintly developed but more densely crowded from the internal towards the external side. Five lateral keels of this sort are counted on the last whorl.

The striæ of growth are turned forward from the slit-keel, and run vertically to the second lateral keel, but are less strongly developed than on the apical portion of the whorl.

The base, which I succeeded in chiseling out from the tough matrix, is regularly but not strongly inflated and covered with very numerous—twenty at least—delicate longitudinal striæ. To those longitudinal striæ are added lines of growth, which are but indistinctly developed. They are directed backward with their concavity turned forward, and converging towards an imaginary centre.

As far as I am able to judge, the aperture was rounded, the umbilicus being almost entirely concealed by the inner lip, which is comparatively well preserved.

The shell is rather thick—about 1 mm.—and spatulate. It is to this thickness of the shell in the present species, that we owe its good preservation, whereas it has been destroyed in all the rest of *Pleurotomariidæ* from the Indian Muschelkalk.

The cast is only visible in a single place, where the shelly substance has been broken off. It exhibits only faint traces of sculpture. The longitudinal keels are noticed in the cast as obtusely-rounded edges.

The measurements of my type-specimen are as follows :—

Height of the entire shell	23 mm.
„ „ „ base	4 „
„ „ „ last whorl	9 „
„ „ „ preceding whorls in the spire	½, 1, 2, 5
Diameter of the whorl of the spire	2½, 4, 7, 11
„ „ „ last whorl	19
Width of the lateral band	5

Locality.—Kágá, Spiti, coll. Hayden.

WORTHENIA DHARMAENSIS nov. sp. Pl. XI, fig. 5.

This type has been based on a fairly well preserved cast, which is provided with a large fragment of the shelly substance adhering to the penultimate whorl. To this type a number of examples in an inferior state of preservation from different localities are more or less nearly allied.

My type-specimen consists of three whorls ; the apical portion of the spire has been broken off.

The last whorl is divided into three parts by the broad lateral band, which runs very regularly parallel to the axis of the spire. The topmost part, corresponding to the apical region, is flatly conical and marked off distinctly from the penultimate whorl by a deeply-incised suture. The thin shelly layer exhibits a shallow excavation running along the upper lateral keel, delicate striæ of growth, with their concavities directed forward, and a series of small, densely-crowded tubercles adjoining the suture.

The lateral band shows a sharply-marked slit-keel, adorned by numerous semilunular notches. To this keel five or six longitudinal lines are added, but their preservation is not good enough to fix their exact number.

The base of the specimen is preserved as a cast only. It is bordered by a strong, spiral keel, separating it from the lateral band, and is vaulted and strongly convex. The transverse section is moderately rounded. The aperture is not known to me.

Dimensions.

Height	27 mm.
Greatest diameter	25 „
Width of the lateral band in the last whorl	5 „

Locality.—Muschelkalk between Dharma and Lissar valleys, coll. La Touche.

A considerable number of specimens are very nearly allied, probably even identical, with this type. From Muth, Spiti, twelve examples are before me, most of them badly preserved. Some examples show the lower keel, which separates the lateral band from the base and is less sharply marked than in my type. Nevertheless, I am not inclined to exclude peremptorily their specific identity, as all these different forms seem to be connected by transitional shapes. A similar variability in this character has been recorded in *Worthenia Loczyi* from the Triassic rocks of the Bakony by Kittl (Triasgasteropoden des Bakonyer Waldes, l. c. p. 5, Taf. 1, figs. 3-9); that species is probably nearly allied to the present one.

A more distant affinity seems to exist between this species and some examples from the lower Muschelkalk of Lilang. Their apical angle is more obtuse, the spire considerably lower. The lateral band is less broad than in the type of *W. Dharmaensis*. Both the topmost keel in the vicinity of the suture and the upper lateral keel of the slit-band are distinctly marked, but the lower lateral keel is but indistinctly developed. The base and external part of the whorl are consequently not sharply separated.

WORTHENIA sp. ind. aff. DHARMAENSIS. Pl. XIII, fig. 4.

Another species, also nearly allied to *Worthenia Dharmaensis*, is represented by a cast from the lower Muschelkalk of Lilang (coll. Krafft), illustrated on Pl. XIII, fig. 4. This species is a little higher than the examples from Lilang quoted above. The penultimate whorl is deeply incised and—in the cast—separated from the following whorl by a deep furrow. The lateral band is incurved conically. On the base some indistinct prominences are noticed.

A specimen from Muth, Spiti, collected together with *Ceratites* (*Hollandites*) *Vyasa* Dien., is in its shape and proportions more nearly allied to the typical form. It is especially distinguished by the development of a number of distinct striæ of growth resembling *varices* and arranged at regular intervals. These striæ of growth run sharply backwards from the suture, cross the lateral band in a forward-turned direction and converge from the lower margin of the band in straight lines across the base of the shell.

Two badly preserved casts of undeterminable *Wortheniæ* were collected in the lower Muschelkalk of Kágá by A. v. Krafft. The upper Muschelkalk of the same locality yielded a very poor cast of a *Worthenia* with a low spire.

Genus: TECTOSPIRA Picard.

TECTOSPIRA GRACILIS nov. sp. Pl. I, fig. 15.

The only specimen available for examination is of low, doubly-conical shape. The thin shelly layer of the cast has been partly preserved. There are three whorls present, which increase in size very rapidly. The apical side and the base converge at a sharp angle in the shape of a double cone. The line along which they meet is marked by a sharp keel, which is also distinctly developed in the cast of the last whorl, but is obtuse, not sharp.

On the apical side a second keel runs parallel to this main keel at a very short distance. A third keel accompanies the suture, which is deeply incised. Those two keels are also indicated on the cast of the last whorl. The shell between them is excavated to form a shallow, concave depression.

The base of the penultimate whorl is ornamented by four notched keels, which are arranged at nearly regular intervals. They are also visible on the cast of the last whorl.

To this longitudinal sculpture distinctly marked lines of growth are added running obliquely backwards in a rather straight direction and indicating the existence of an aperture, which is cut off obliquely. The aperture itself has not been preserved. The notched character of the longitudinal keels is due to the crossing of spiral and radial elements of ornamentation.

The measurements of this elegant, richly sculptured shell are as follows:—

Entire height	10 mm.
Longest diameter	12 „
Diameter of the penultimate whorl	6 „

Locality.—Lower Muschelkalk, Lilang, coll. A. v. Krafft.

Remarks.—The generic position of this specimen is not certain, although it appears to be most nearly allied to *Tectospira.* This generic designation has been assigned by Picard to *T. Clopi* (Beitræge zur Kenntnis der Glossophoren der mitteldeutschen Trias, Jahrb. kgl. preuss. geol. Landesanst. f. 1901, Bd. XXII, p. 479), which was formerly united with *Pleurotomaria,* and has been grouped among the family of *Trochonematidæ.* Its principal characters are roof-shaped whorls with spiral keels. In those characters our species agrees fairly well with *Tectospira,* but an identification is barely possible, because the shape of the aperture is not known to me. In comparison with *Tectospira Clopi* my Indian species has its spire considerably more depressed, nevertheless this is no sufficient reason for excluding an identification with the latter genus.

I may be allowed to hint at the presence of a similar type among the fauna of Gasteropoda from the Feuerkogel near Aussee. Koken in his memoir on the Gasteropoda of the Hallstatt limestone has, on Pl. XXIII, fig. 17, illustrated a small shell, which he considered specifically undeterminable but nearly allied to the family of *Trochonematidæ.* To this type the present species might also be compared.

Genus: OMPHALOPTYCHA v. Ammon.

OMPHALOPTYCHA SMITHII nov. sp. Pl. XI, fig. 7.

Omphaloptycha, by which name the group of *Chemnitzia Maironii* is designated by J. Boehm (Gastropoden der Marmolatakalke, Palæontographica, XLII, p. 274) and Koken, is a type very characteristic of limestones of middle Triassic age. It is especially the limestone of Esino and of the Marmolata of the ladinic stage, the fauna of which contains a considerable number of species, most of them of large size.

In comparison with those species the present one is remarkable for its small dimensions. In this respect it agrees with some representatives of the genus from the German Muschelkalk, especially with *Omphaloptycha liscaviensis* Gbl. Nevertheless, I prefer to abstain from a direct identification of the Indian and German forms. Such an identification of species from localities so far distant should not be attempted, in my opinion, except in cases where a large number of examples from both localities are indistinguishable from one another.

Notwithstanding their remarkable similarity the types from India and Germany can be kept separate, although in very subordinate details only. My species of *Omphaloptycha* from Byans agrees, it is true, with *O. liscaviensis* in the number of whorls (7), in its height and greatest width, but differs by the slightly more obtuse apical angle, measuring about 60°. The whorls are strongly inflated and marked off from each other by distinct steps.

The surface is nearly smooth. Delicate spiral rows of grooves are less distinctly indicated than in *O. liscaviensis* and are considerably inferior in strength to the lines of growth. The aperture is somewhat less high and more strongly inflated externally. A basal notch or canal may, perhaps, have been present.

The measurements of my type-specimen are as follow :—

Entire height	17 mm.
Height of the last whorl	11 „
Greatest diameter	11 „

Locality.—Jolinka, Byans, coll. F. H. Smith.

OMPHALOPTYCHA (?) sp. ind. Pl. XI, fig. 8.

An incomplete specimen, strongly deformed by pressure but with shell preserved, is probably most nearly allied to the genus *Omphaloptycha*. The state of preservation, however, excludes a certain identification. Nor is it advisable to introduce a specific denomination.

The present fragment seems to have belonged to a spire of considerable size. It consists of half of the last whorl and two preceding whorls, measuring 36 mm. in height and 18-28 mm. in diameter. The amount of deformation is, however, considerable, especially along the two diameters. The whorls are strongly inflated and increase rapidly in width. The spire was probably depressed, the aperture of nearly circular shape.

The shelly substance is comparatively thick and consists of two layers, the inner being smooth, the outer provided with a delicate ornamentation. This ornamentation is a network of very regularly-arranged and densely-crowded longitudinal lines crossed by faintly-marked striæ of growth.

Locality.—Kágá, Spiti, coll. Krafft.

Genus: PSEUDOMELANIA Pictet.

PSEUDOMELANIA sp. ind. Pl. I, fig. 14.

With this name I designate two high, turretted shells belonging to the family of Triassic *Pyramidellidæ*. Similar forms are rather numerous in the Alpine and German Trias. Picard (l. c. Taf. XIV, fig. 1) illustrates *Rhabdoconcha Fritschi*, a species agreeing with the present one in many respects.

One of my two examples is only a cast exhibiting four high whorls with sharply-impressed sutures. Its height is 20 mm., and its greatest diameter 10 mm.

The second specimen, which has been taken for illustration, has three whorls and is somewhat deformed, but provided with its shelly layer. The shell is thin and covered with slightly falciform striæ of growth, which are delicate but distinctly marked. In its proportions, this specimen agrees pretty well with the first one, so far as can be made out from its shape, which has been much deformed by pressure.

The apertural region is badly preserved, but traces of a slit are visible on the inner lip of the aperture. The height of this specimen is 19 mm., the greatest diameter 15 mm., but the great deformation which the specimen has suffered from pressure must be taken into consideration.

Although the specific identity of those two examples is very probable, we cannot go beyond an identification with the genus *Pseudomelania*, and the introduction of a new specific denomination has been avoided in view of their bad state of preservation.

Locality.—Muth, Spiti, coll. Krafft.

UNDETERMINABLE FORMS. (Pl. XIII, fig. 3, Pl. XI, fig. 6.)

I wish to mention a cast, illustrated on Pl. XIII, fig. 3, because it is the only representative of a faunistic element among the Gasteropoda of the Himálayan Muschelkalk which shows no relationship whatever to other members of this faunula. As will be seen from the illustration, fragments of two roof-shaped whorls have been preserved. The base is marked off in a sharp angle from the slightly concave apical side, both of them meeting in an obtuse edge and being covered with spiral lines. The entire shell was probably of a doubly-conical shape but too low and depressed to unite it with either *Promathildia* or *Anoptychia*, which in their casts take similar shapes.

The second fragment, illustrated in Pl. XI, fig. 6, might perhaps, indeed, be compared with *Promathildia* Andreæ. It belongs to a turretted form with a high spire. The cast of two whorls has been preserved. They project slightly beyond one another and exhibit a steeply roof-shaped, smooth apical side and a flatly-vaulted base.

Owing to the imperfect state of the fragment the systematic position of this cast could not be ascertained.

Locality.—Both specimens were collected in the Muschelkalk of Muth, Spiti, by A. v. Krafft.

Class: CEPHALOPODA.

Order: DIBRANCHIATA.

Family: *BELEMNITIDÆ.*

Genus: ATRACTITES Guembel.

ATRACTITES SMITHII nov. sp. Pl. I, fig. 13.

Fragments of large phragmocones from the Muschelkalk of Jolinka, Byans, (coll. Smith) with an elliptical transverse section and with an angle of divergence of 10°. The ventral and dorsal sides are broader than the lateral parts, which correspond to the larger diameter of the transverse section.

The most peculiar character of this species is the arrangement of the septa, which slope very strongly from the dorsal to the ventral side along the lateral parts of the cast. The distance between two septa is less than one-third of the diameter of the preceding air-chamber.

All my specimens are casts, without any trace of the shelly substance.

Atractites subundatus Muenster (E. v. Mojsisovics, Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst. X, p. 301, Taf. XCII, fig. 6) recalls this species by the presence of septa ascending obliquely from the ventral to the dorsal side, but this character is considerably less strongly developed than in *A. Smithii*, which is distinguished from all other congeneric forms by this remarkable feature.

Measurements of the figured cast.

Larger diameter of the distal septum	27·5	mm.
Smaller „ „ „ „ „	22	„
Larger diameter of the proximal septum	17	„
Smaller „ „ „ „ „	15	„
Distance between the two last septa	8	„
Length of the entire cast	70	„

Order: NAUTILOIDEA.

Family: *ORTHOCERATIDÆ.*

Genus: ORTHOCERAS Breynius.

1. ORTHOCERAS cf. CAMPANILE Mojs.

1882. *Orthoceras campanile* E. v. Mojsisovics, Cephalopoden der Mediterranen Triasprovinz Abhandl. K. K. Geol. Reichsanst., X, p. 291, Taf. XCIII, figs. 1-4, 11.
1896. *O. cf. campanile* Diener, Himál. Foss., Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 87, Pl. XXVIII, fig. 8.

Of this common Triassic species examples consisting of air-chambers and of body-chambers have been collected in the Muschelkalk of Jolinka (Byans) by Smith, of Lilang (Spiti) by Hayden, and in the beds with *Spiriferina Stracheyi* of the Shalshal and Bambanag sections by A. v. Krafft.

The specimen from Lilang is very thin and elongated. The diameter of the last septum is only 6 mm. in length. The body-chamber, which has been partly preserved, is about one-third the entire length of the cast.

In all my specimens the distance between two septa is considerably smaller than the diameter of the lower septum and the angle of emergence less than 5°. The position of the siphuncle is central. Thus I cannot find any reason against an identification of my Himálayan examples with *O. campanile.*

2. ORTHOCERAS cf. MULTILABIATUM v. Hauer. Pl. II, fig. 2.

1887. *Orthoceras multilabiatum* v. Hauer, Die Cephalopoden des bosnischen Muschelkalkes von Han Bulog bei Sarajevo, Denksch. Kais. Akad., LIV, p. 11, Taf. II, figs. 3-5.

The cast of a body-chamber from the Muschelkalk (zone of *Spiriferina Stracheyi*) of the Shalshal cliff (coll. A. v. Krafft) is distinguished by the presence of two moderately-deep annular constrictions, corresponding to varices of the shell. The entire length of the cast is 58 mm. The lower varix is situated immediately in front of the last septum, which has been preserved, the second at a distance of 12 mm. from the former. In the rest of its characters the cast agrees with *Orthoceras dubium* v. Hauer. Its transverse section is circular, with a central siphuncle and with a diameter of 16 mm. in length, corresponding to the last septum. The angle of emergence is very small.

The presence of annular varices points to a species very nearly allied to *Orthoceras multilabiatum* from the Bosnian Muschelkalk. The specific identity remains, however, questionable without any knowledge of the chambered portions of the shell, which are also provided with distinct varices in *O. multilabiatum.*

3. ORTHOCERAS SPITIENSE nov. sp. Pl. II, fig. 1.

This species differs from all other congeneric forms from the Trias of the Eastern Alps by its large angle of emergence, which imparts to it an external similarity to *Aulacoceras inducens* Braun or to *Atractites obeliscus* Mojs., but the central position of the siphuncle within the circular transverse section of the air-chambers and the straight direction of the septa peremptorily exclude any identification with either *Atractites* or *Aulacoceras*.

The only specimen from the Muschelkalk of Muth (coll. Hayden) consists of air-chambers, the short part in front of the last septum being a fragmentary portion of the body-chamber. The distance of the different septa from each other is a little more than one-half the diameter of the lower chamber. To an entire length of the specimen of 96 mm. a diameter of 7·5 mm. in the lowest and of 24 mm. in the topmost air-chamber correspond. The height of the last preserved air-chamber is 9 mm.

Angle of emergence about 11°. Shell not preserved.

Family: *NAUTILIDÆ.*

Sub-family: TEMNOCHEILINÆ.

Genus: PLEURONAUTILUS Mojs.

1. PLEURONAUTILUS sp. ind. aff. ORNATO v. Hauer. Pl. II, fig. 4.

This species from the Muschelkalk of Jolinka, Byans (coll. Smith), is very nearly allied to *Pleuronautilus ornatus* v. Hauer (Die Cephalopoden des bosnischen Muschelkalkes von Han Bulog, Denkschr. Kais. Akad. d. Wiss., LIV, 1887, p. 17, Taf. III, figs. 2, 3) from the Bosnian Muschelkalk.

The only specimen available for examination is unfortunately incomplete—neither the body-chamber nor the innermost volutions have been preserved—and strongly distorted through pressure, as are nearly all the fossils from this locality.

The whorls overlap each other very little, are wider than high, very broadly-vaulted above and not provided with any median depression. The transverse section is trapezoidal; its greatest width corresponds to the umbilical margin. The lateral parts are flattened and separated from the high and perpendicular umbilical wall by a distinct marginal edge.

The sculpture is very characteristic. It consists of strongly-developed, straight, lateral ribs, which rise from the umbilical margin, and of external tubercles or spines, which are separated from the ribs by a narrow spiral zone, along which the sculpture is completely interrupted. The umbilical wall is entirely smooth. This is the same pattern of ornamentation as has been described in *Pl. ornatus* by

F. v. Hauer. It differs from the latter by the absence of distinctly marked tubercles on both ends of each rib, and in the smaller number of external or marginal tubercles. In *Pl. ornatus* the number of external spines is nearly twice as large as the number of ribs. In my Himálayan specimen one single external spine corresponds, as a rule, to every rib. Very rarely a sort of bifurcation is noticed, by which two external spines originate from a single lateral rib.

From *Pl. planilateratus* v. Hauer (E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, Suppl., Abhandl. K. K. Geol. Reichsanst., VI-1, Taf. IX, fig. 3), which F. v. Hauer considered to be the nearest ally to his Bosnian species, our Himálayan specimen is at once distinguished by its much more strongly developed sculpture and by the absence of any longitudinal striation.

F. v. Hauer states that the generic features of his species were not sufficiently well marked to decide its identification with either *Pleuronautilus* or *Temnocheilus*. My Himálayan specimen does not afford any reason for a similar uncertainty. There can be no doubt that it belongs to the genus *Pleuronautilus*.

Dimensions.

Diameter of the shell (shorter axis)	53	mm.
„ „ „ umbilicus	14·5	„
Height of the last volution	21	„
Thickness „ „ „	27	„

Sutures.—Lateral lobe deeply sinuous and rounded below. Siphonal lobe shallow. A moderately arched siphonal saddle corresponds to the external, a small umbilical saddle to the umbilical, margin. Annular lobe present.

Siphuncle.—A little below the centre of the septum.

2. PLEURONAUTILUS sp. ind. aff. ROLLIERI Arth. Pl. II, fig. 5.

This species is related to *Pleuronautilus Rollieri* G. v. Arthaber (Cephalopodenfauna der Reiflinger Kalke, Beitræge zur Palæontologie Oesterr.-Ungarns, etc., X. 1895, p. 29, Taf. I, fig. 4) and *Pl. furcatus* Arth. from the Muschelkalk of Grossreifling in the north-eastern Alps.

The only specimen available for examination is provided with its body-chamber. Its transverse section is nearly rectangular, the greatest transverse diameter corresponding with the umbilical margin and being equal to the height. The siphonal area is flatly arched. Umbilical and siphonal margins sharply rounded, but not acute. Whorls increasing very slowly, enclosing a wide umbilicus and enveloping each other along the siphonal area only.

The sculpture consists of straight ribs, which originate in a small tubercle at the umbilical margin and terminate rather abruptly near the siphonal margin, forming a second tubercle. A row of lateral tubercles stands very near the row of external ones. Between those two rows the ribs are occasionally depressed but do not become obsolete. The zone of external tubercles gradually dies out on the body-chamber. Sixteen lateral ribs are counted in the last volution.

Dimensions.

Diameter of the shell	43 mm.
„ „ „ umbilicus	14·5 „
Height of the last volution	18 „
Thickness „ „ „	19 „

Sutures.—Septa apparently similar to those of the preceding species, but not entirely known to me.

Siphuncle.—Below the centre of the septum.

Locality : number of specimens examined.—Jolinka (Byans) 1, coll. Smith.

Remarks.—The propriety of placing this species in the genus *Pleuronautilus* is perhaps questionable. *Pleuronautilus*, according to the diagnosis given by E. v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, Supplem., p. 237), includes *Temnocheilinæ* with strongly-developed falciform ribs, which are frequently adorned with tubercles. Such forms in which a tendency towards the obliteration of the lateral ornamentation is marked in old age and in which the sculpture consists principally of straight ribs or pilæ, ending in tubercles, have been united in the genus *Mojsvaroceras* by Hyatt. The presence of three rows of tubercles in the present species and its affinity to some true representatives of *Pleuronautilus* from the Alpine Muschelkalk have induced me to class it among the latter genus.

3. PLEURONAUTILUS sp. ind. aff. CRASSESCENS Arth. Pl. III, fig. 3.

A small specimen of *Pleuronautilus* from the Muschelkalk of the Shalshal cliff (coll. A. v. Krafft) is, in its general shape, involution and size exactly like *Pl. crassescens* G. v. Arthaber (Cephalopodenfauna der Reiflinger Kalke, Beitræge zur Palæontologie, etc., X, 1896, p. 37, Taf. III, fig. 1). The sculpture consists of radiating, slightly-curved ribs, which persist on the body-chamber and are not adorned by any tubercles. The radial ornamentation is crossed by a distinct spiral edge, corresponding to the siphonal margin, as in *Pl. Cornaliæ* Stopp. Besides this no other spiral line has been noticed in the sculpture of the shell, which is altogether more delicate than in *Pl. crassescens*.

The combination of radiating and spiral elements of ornamentation induces me to place our species among the representatives of the group of *Pleuronautilus subgemmatus* Mojs. (sub-genus *Trachynautilus*).

Dimensions.

Diameter of the shell	32 mm.
„ „ „ umbilicus	8·5 „
Height of the last volution	14 „
Thickness „ „ „	16 „

Sutures.—Septa rather distant, even in the vicinity of the body-chamber, to which a little less than one-half of the last volution belongs. Lateral lobe shallow. No external lobe present. The septa cross the rounded siphonal part in a straight line.

Siphuncle.—Not known.

Genus: MOJSVAROCERAS Hyatt.

The genus *Mojsvaroceras* has been proposed by Hyatt for such forms of *Temnocheilinæ* as are distinguished by the presence of straight pilæ on their flanks, terminating in marginal and umbilical tubercles. This group of forms, which has some typical representatives among the *Temnocheilinæ* of upper Carboniferous and Permian age (*M. Nikitini* Twetzœw, *M. Veræ* Arthab.), is represented in the Himálayan Muschelkalk by four species. There is, unfortunately, but one single specimen of each species available to me for examination, and even these, in two cases at least, are rather incomplete. It may not be considered prudent to describe or identify a species of the *Nautilidæ* from a single, incomplete specimen only; but, on the other hand, *Nautilidæ* have up to now been found so rarely in the Himálayan Muschelkalk, that I did not like to leave them aside. If a full account of the *Nautilidæ* of this horizon is to be given, it is necessary to include descriptions of these peculiar types, although some of their characters can only be made out imperfectly.

1. MOJSVAROCERAS sp. ind. aff. MORLOTI Mojs. Pl. II, fig. 7.

The only specimen from the Muschelkalk of Jolinka, Byans (coll. Smith), is very nearly allied to *Mojsvaroceras Morloti* v. Mojsisovics (Die Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X., p. 268, Taf. LXXXVIII, fig. 3). It is only distinguished from this species by its strongly elliptical outlines, a feature common to all the cephalopoda from this locality. If this character could be proved to be accidental only, due to a deformation through pressure, the identity of the Alpine and Himálayan forms might even be taken into consideration.

The whorls, which overlap one another a little more than one-third their height, increase more rapidly in thickness than in height. The transverse section is of nearly equal height and width. The greatest transverse diameter is situated above the umbilical margin. Siphonal area broad and flat, without any median depression. Siphonal and umbilical margins forming sharp edges; umbilical wall high and vertical.

As in *M. Morloti* from the Muschelkalk of the Salzkammergut, the ornamentation consists of numerous and small marginal tubercles only. Neither pilæ nor umbilical tubercles are present, not even in the inner volutions.

Dimensions.

Longer diameter of the shell	66 mm.
Shorter " " " "	36 "
Longer diameter of the umbilicus	15 "
Shorter " " " "	7·5 "
Height of the last volution corresponding to the longer diameter	32 "
Height of the last volution corresponding to the shorter "	19 "
Width of the last volution corresponding the longer diameter	30 "
Width of the last volution corresponding the shorter "	23 "

The shell, which has been partly preserved, is covered with numerous and very delicate transverse striæ of growth.

Sutures.—Septa close to each other. Siphonal lobe very shallow. Lateral lobe moderately deep. Umbilical saddle not distinctly marked.

Siphuncle.—Below the centre of the septum.

2. Mojsvaroceras nivicola nov. sp. Pl. II, fig. 6.

I look upon a specimen from the Muschelkalk of Jolinka, Byans (coll. Smith), as a representative of *Mojsvaroceras* distinguished by a very strongly marked tendency towards the obliteration of the primitive lateral sculpture. At the beginning of the last volution, the lower portion of the flanks is covered with narrow, straight pilæ of unequal strength, which disappear completely on the body-chamber. Nor do the delicate marginal tubercles persist throughout the entire length of the last volution, although they continue for some distance beyond the region where the lateral ornamentation disappears completely.

This species belongs to a group of forms, which in the Alpine Trias is chiefly represented by such species of *Mojsvaroceras*, as have been described from the Muschelkalk of Han Bulog by F. v. Hauer. But my Himálayan species does not exhibit a closer affinity to any of the Bosnian species. It is distinguished by its strongly-elliptical outlines and by its trapezoidal transverse section. The greatest width, which considerably surpasses its height, corresponds with the sharp umbilical margin. Umbilical wall steep, almost vertical. Siphonal area flat, not arched.

If we make exception for the difference in outlines and in the shape of the transverse section, *M. Kellneri* v. Hauer (Denkschr. Kais. Akad. d. Wiss., Wien, LIV, p. 14, Taf. II, fig. 2) agrees pretty well with our species in the character of its sculpture.

The inner volutions of my specimen are not sufficiently well preserved to decide whether the coils were perforated or not.

As this specimen is somewhat deformed, I have not been able to take exact measurements. As to its dimensions, I must therefore refer to the figure.

Sutures.—Septa close to each other with well individualised siphonal and umbilical saddles. Siphonal lobe shallow, lateral lobe comparatively deep.

Siphuncle.—Not known.

3. Mojsvaroceras Kagæ nov. sp. Pl. II, fig. 8.

This species, although to some extent recalling *Mojsvaroceras binodosum* Hauer (Beitræge zur Kenntniss der Cephalopoden aus der Trias von Bosnien, Denkschr. Kais. Akad. d. Wiss., LXIII, 1896, p. 279, Taf. I, figs. 3-4), is distinguished from all congeneric Alpine forms by its very slowly increasing whorls, which overlap one another along their siphonal part only. The shell is widely umbilicated, with a transverse section, which is octagonal in the inner and square in the outer volutions. The last volution is of equal height and width. Siphonal area very gently arched, lateral parts flat and equi-distant throughout their entire extent. Umbilical wall high and steep, but not perpendicular.

In its external sculpture this species agrees with ***M. Augusti*** v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 267, Taf. XC, figs. 1, 2) in the absence of pilæ or ribs. The ornamentation consists of strong umbilical and marginal spines, which are sharply pointed and rise from a circular base. As a rule, one marginal spine corresponds to an umbilical one, but exceptionally the number of marginal spines corresponding to an umbilical one is two. In the penultimate whorl traces of indistinct pilæ are noticed along the middle portion of the lateral parts.

Dimensions.

Diameter of the shell	58 mm.
„ „ „ umbilicus	23 „
Height of the last volution	20 „
Thickness „ „ „	20 „

Sutures.—A shallow siphonal lobe and a deep, rounded lateral lobe have been noticed. My fragmentary specimen consists of air-chambers only.

Siphuncle.—Approximately central in its position.

Locality: number of specimens examined.—Upper Muschelkalk, Kágá (Spiti), 1, coll. Hayden.

4. MOJSVAROCERAS sp. ind. aff. KAGÆ. Pl. II, fig. 9.

A fragmentary specimen from the Muschelkalk of Muth, Spiti (coll. Hayden), consisting of air-chambers only, is very closely allied to ***Mojsvaroceras Kagæ***. Its volutions increase more rapidly, a diameter of the shell of 70 mm. corresponding to a width of the umbilicus of 21 mm. only. The transverse section is not square but trapezoidal, the greatest width coinciding with the umbilical margin. The sculpture agrees in general with that of ***Mojsvaroceras Kagæ***, but traces of stout pilæ are more distinctly marked near the end of the penultimate whorl. In the last volution the ornamentation is reduced to umbilical and marginal spines. The example is too badly preserved to state with certainty whether those spines persist or not in the anterior portion of the shell.

I am, unfortunately, not able to give an adequate figure of the sculpture of this specimen, which has been greatly injured by weathering. The chief difference between the present species and ***M. Kagæ*** may be seen from a comparison of their respective transverse sections.

Sutures.—Agreeing with those of ***M. Kagæ***. From the umbilical margin the septa run in a straight line down to the umbilical suture.

Siphuncle.—Below the centre of the septum.

Genus: THURINGIONAUTILUS Mojs.

THURINGIONAUTILUS sp. ind. Pl. II, fig. 3.

Two Triassic species, formerly included by E. v. Mojsisovics in the Palæozoic genus *Trematodiscus* Meek and Worthen, have been recently classed among the forms related to *Nautilus jugatonodosus* Zimmermann (Jahrb. Kgl. Preuss. Geol. Landesanstalt, 1889, p. 322), for which the new genus *Thuringionautilus* has been proposed. This interesting genus of *Nautilidæ*, of which two representatives only are as yet known from the upper Trias of the Eastern Alps, is certainly represented in the Muschelkalk of the Himálayas. Although this Indian representative is an imperfect fragment only, not worthy of a specific denomination, it must be mentioned here on account of the interest which the discovery of *Thuringionautilus* in the Himálayan Trias deserves.

The fragment from the upper Muschelkalk of Kágá, Spiti (coll. Hayden), is not sufficient for a reconstruction of the shell, but its peculiar sculpture does not leave any doubt as to its identity with *Thuringionautilus*. A shallow median depression of the siphonal area is bordered by continuous spiral ridges. Outside those spiral ridges a second spiral row of indistinct marginal tubercles follows. The tubercles are very low and elongated spirally. The next row of tubercles, which are stout and strongly developed, occupies a marginal position. They are connected with umbilical tubercles by low and broad pilæ running straight across the narrow and flat lateral parts.

The similarity in ornamentation to *Thuringionautilus Klipsteini* E. v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandlungen K. K. Geol. Reichsanst., X, p. 271, Taf. LXXXIX, fig. 2) is obvious, although the two species differ very considerably in their outlines and in the shape of their transverse section.

Siphuncle.—Below the centre of the septa, which apparently agree with those of *Th. Klipsteini.*

A second specimen of *Thuringionautilus* from the Muschelkalk of Muth, Spiti (coll. Hayden), probably belongs to a different species, but is too poorly preserved to permit a specific description. The principal difference consists in the more strongly inflated section of the outer whorl and in the presence of higher siphonal and marginal ridges.

Genus: GERMANONAUTILUS Mojs.

GERMANONAUTILUS cf. SALINARIUS v. Mojs. Pl. III, fig. 1.

1882. *Nautilus salinarius* E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 282, Taf. XCI, fig. 3.

Two specimens from the Muschelkalk of Muth, Spiti (coll. Hayden), are probably identical with this type of smooth-shelled *Nautilidæ* from the Alpine Trias.

The better preserved example, which consists of air-chambers and of a small portion of the body-chamber, agrees in its outlines, involution and transverse section with the specimen from the Schreyer Alpe illustrated by E. v. Mojsisovics.

The whorls are strongly inflated, considerably broader than high, and envelope one another to about one-half their height. Both the umbilical and siphonal margins are obtusely rounded. The umbilical wall is very high and perpendicular, not vaulted.

Dimensions (of the chambered nucleus).

Diameter of the shell	76 mm.
„ „ „ umbilicus	17 „
Height of the last volution	37 „
Thickness „ „ „	51 „

Sutures.—Septa close to each other. No siphonal lobe developed. Septa crossing the external area in a nearly straight line, but describing a shallow lobe on the lateral parts. Annular lobe present.

Siphuncle.—Below the centre of the septum.

Remarks.—The differences between my Himálayan examples and the Alpine type-specimen illustrated by E. v. Mojsisovics are insignificant. In my specimens the inflation is a little more strongly marked, the last volution is more expanded and the umbilicus is a little wider. Nevertheless their resemblance is so great that many palæontologists would consider them identical.

Sub-family: SYRINGONAUTILINÆ Mojs.

Genus: SYRINGONAUTILUS v. Mojs.

SYRINGONAUTILUS SPITIENSIS Stoliczka.

1865. *Nautilus spitiensis* Stoliczka, Memoirs Geol. Surv. of India, Vol. V, Pt. 1, p. 49, Pl. IV, fig. 2.
1895. *Nautilus spitiensis* Diener, Himálayan Foss. Pal. Indica, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 86, Pl. XXVIII, fig. 5.

The new genus *Syringonautilus* was proposed by E. v. Mojsisovics in 1902 (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, Supplementbd., p. 220) for the accommodation of *Nautilus lilianus* and its allies. That E. v. Mojsisovics was right in placing *Nautilus spitiensis* in this new genus, is proved by the examination of two well-preserved examples of this species from Kágá, Spiti (coll. Hayden), in which some of the generic characters of *Syringonautilus* are exhibited, which were not known to me when describing Stoliczka's type-specimen.

One of those two specimens, with a diameter of 51 mm., consists of air-chambers only, but in the second specimen the body-chamber, to which nearly one-half of the last volution belongs, begins at a diameter of 35 mm. The first specimen and the chambered parts of the second have a tube-shaped transverse section with regularly rounded-off margins, whilst in the body-chamber the section gradually becomes square, as in typical *Syringonautilinæ*, and the siphonal area becomes flattened and marked off from the flanks by obtusely rounded edges. The discovery of these features in adult individuals of *N. spitiensis*—in Stoliczka's type-specimen only the posterior termination of the body-chamber had been preserved—demonstrates the correctness of grouping the present species among the representatives of *Syringonautilus*.

Another feature characteristic of the ornamentation of the shell in *Syringonautilus* has been noticed in this specimen. Large fragments of the shell, adhering to the matrix, exhibit thin transverse striæ of growth crossed by delicate spiral lines, exactly as in *S. Carolinus*.

My larger specimen, in a complete state of preservation, must have been provided with at least two and a half volutions.

Sub-family: GRYPONAUTILINÆ Mojs.

Genus: GRYPOCERAS Hyatt.

1. GRYPOCERAS GRIESBACHI Diener.

1895. *Nautilus Griesbachi* Diener, Palæontologia Indica, ser. XV, Himálayan Foss., Vol. II, Pt. 2. The Cephalopoda of the Muschelkalk, p. 85, Pl. XXVIII, figs. 6, 7.

A beautifully-preserved example of this species of the group of *Gryposeras Palladii* Mojs. was collected from the Muschelkalk of Kágá, Spiti, by Hayden. It is somewhat less elliptical in its outlines than my type-specimens from Kalapani, but agrees with them very closely in the rest of its characters.

The shell, which has been partly preserved, is covered with numerous very delicate striæ of growth.

One-quarter of the last volution belongs to the body-chamber.

2. GRYPOCERAS sp. ind. ex. aff. G. PALLADII Mojs.

A large specimen of *Grypoceras*, with part of its body-chamber preserved, is nearly allied to *G. Palladii* E. v. Mojsisovics (Die Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 225, Taf. XCII, fig. 2) from the Alpine Muschelkalk. It is distinguished from this species by its greater width, broader external area and by the less strongly oblique slopes of its lateral parts. The greatest transverse diameter coincides with the umbilical edge, but in length does not exceed the distance between the two siphonal margins so considerably as in *G. Palladii*. In involution and sutures the two species agree entirely.

Dimensions (of the chambered portion of the shell).

Diameter of the shell	87 mm.
„ „ „ umbilicus	19 „
Height of the last volution	47 „
Thickness „ „ „	46 „

The diameter of the entire specimen is 110 mm.

Siphuncle.—A little below the centre of the septum.

Sutures.—Agreeing with those in *G. Palladii.*

Locality: number of specimens examined.—Ridge between Dharma and Lissar valleys 1, coll. La Touche.

Sub-family: CLYDONAUTILINÆ Mojs.

Genus: PARANAUTILUS v. Mojsisovics.

1. PARANAUTILUS BULLOCKII nov. sp. Pl. III, fig. 2.

A small species of a smooth *Nautilus* with strongly-expanding body-chamber volution and with a narrow umbilicus will find its systematic position among the forms related to *Nautilus Simonyi* F. v. Hauer (*Paranautilus*). It appears to be allied to *Paranautilus sp. ind.* E. v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 282, Taf. XCI, fig. 4) from the red marble of Pozoritta (ladinic stage) but is of much more globose shape. The volutions are strongly inflated, with rounded margins and with a highly arched siphonal part. The deep umbilicus is surrounded by a vertical wall.

In the tube-shaped character of the whorls the species recalls *Syringoceras*, from which it is distinguished by its small, funnel-shaped umbilicus and by the persistence of the vaulted character of the siphonal part in the body-chamber.

Sutures.—Septa close to each other, running straight across the siphonal part. Lateral lobe very shallow, barely developed. No umbilical saddle.

Dimensions.

Diameter of the shell	40 mm.
" " " umbilicus	6 "
Height of the last volution	20 "
Thickness " " "	33 "

Locality: number of specimens examined.—Muth (Spiti) 1, coll. Hayden.

2. PARANAUTILUS nov. sp. ind.

A very large species of *Paranautilus* is represented by two specimens, consisting of air-chambers only, from the Muschelkalk of Kágá, Spiti (coll. Hayden).

The diameter of the larger example is 130 mm. Both specimens are very strongly inflated, nearly as broad as, or broader than, high and provided with only a very small umbilicus. From *P. Simonyi* F. v. Hauer (Neue Cephalopoden aus den Marmorschichten von Hallstatt und Aussee, Haidinger's Naturwissenschaftl. Abhandl. III, 1849, p. 5, Taf. I, fig. 12-14) they differ by their larger size, their more globose shapes and their flattened siphonal area. In the latter character they recall *P. bambanagensis* E. v. Mojsisovics (Denkschr. Kais. Akad. d. Wissensch., LXIII, p. 672, Taf. XXI, fig. 1).

The siphuncle is very deep in its position, exactly as in *P. Simonyi*, the prototype of the genus. The siphonal and lateral lobes are extremely shallow.

I am not sure whether the two Himálayan specimens ought to be placed in one single or in two different species, one of them surpassing the other considerably in the inflation of its volutions. In the transverse section of this specimen a width of 76 mm. corresponds to a height of 68 mm., whereas in the second example height and width are equal (80 mm.)

Both specimens are too poorly preserved to be fit for illustration.

Order: AMMONOIDEA.

A. CERATITOIDEA.

Genus: Ceratites de Haan.

The *Ceratitidæ* of the Himálayan Muschelkalk comprise very numerous forms, which seem to be developed in quite an exceptional manner in this horizon, of which they are the chief leading fossils.

The number of forms included in the genus *Ceratites* up to 1895 by different authors, had become very large, and an exceptionally wide range has been given to the genus. Philippi, in his most valuable monograph of the Ceratites of the German Muschelkalk (Palæontologische Abhandlungen von Dames und Koken, VIII, 1901, Heft 4), was the first to show that the range attributed to *Ceratites* by E. v. Mojsisovics, Waagen and myself, was no longer in accordance with the general custom of the interpretation of the extent of other Mesozoic genera of ammonites. According to his view, the genus *Ceratites* in the interpretation of previous authors is decidedly polyphyletic. In order to arrive at purely monophyletic elements of classification he proposes to exclude from the genus large groups of forms allied by remarkable proper characters and by developmental connection. As groups which ought to be excluded from the genus *Ceratites*, he considers: *Ceratites nudi* E. v. Mojsisovics (*Apleuroceras* Hyatt), *C. obsoleti* v. Mojsisovics (*Danubites* Mojs.), *C. subrobusti* v. Mojsisovics (*Keyserlingites* Hyatt, *Robustites* Phil.), *C. polaris* Mojs. (*Arctoceras* Hyatt) and nearly all the Ceratites of the Salt Range described and illustrated by Waagen. The propriety of including the Indian group of *C. circumplicati* in the genus *Ceratites* appears to him rather questionable, but he avoids giving a decided opinion on this subject.

In his revision of the Cephalopoda for the English edition of Zittel's text-book of Palæontology (London, 1900) Hyatt has also made an attempt to avoid the difficulty of conceding an unusually wide interpretation to the genus *Ceratites* by uniting some of its groups into proper genera or sub-genera. Thus the genera or sub-genera *Apleuroceras, Paraceratites, Keyserlingites* and *Arctoceras* have been proposed. But Hyatt's attempt at classification has been, unfortunately, almost entirely restricted to the introduction of those new denominations. Neither a diagnosis of the new genera nor a discussion of their affinity to one another nor of their developmental connection has ever been published.

The beautiful materials entrusted to me for examination, have yielded so many new and unexpected results, that I feel justified in establishing a new basis for a systematic classification of the genus *Ceratites*. As I cannot agree with Philippi in all the views expressed in his memoir on the Ceratites of the German Muschelkalk, I am obliged to discuss the subject more thoroughly. This discussion will, however, be confined to the Ceratites of the Indian Triassic province and Ceratites of other regions will be treated only so far as may be necessary.

Before entering into this discussion I may be allowed a few introductory remarks. I am well aware that a fundamental postulate of all classifications in palæontology is the principle that all genera ought to be strictly monophyletic. Philippi undoubtedly believes that he is acting in accordance with this postulate in removing from the genus *Ceratites* all groups of forms the real developmental connection of which appears to him uncertain. For the ancestor of *Ceratites* he looks among the genera closely allied to ***Meekoceras*** Hyatt.

Ceratites s. str. from Meekoceras

Keyserlingites from Olenekites

The valuable researches on the Arctic Cephalopoda by E. v. Mojsisovics have given full evidence of an uninterrupted evolutional series, which connects the group of *Dinarites spiniplicati* (*Olenekites* Hyatt) with that of *Ceratites subrobusti* (*Keyserlingites* Hyatt). He consequently infers that *Keyserlingites* and *Ceratites* (*sensu stricto*), having sprung from two different roots, must be kept separate and cannot be united in the same genus.

An examination of a very large amount of material has convinced me of the impossibility of adhering strictly to this principle, although I am far from questioning its theoretical correctness. This examination has led to the discovery of some most remarkable cases of convergence, which put enormous difficulties in the way of a classification based solely on the principle of developmental connection. When we find that the ontogeny of two forms (*Ceratites Vyasa* and *Ceratites Devasêna*) whose outer volutions cannot be distinguished, is nevertheless entirely distinct, that the same remark applies to *C. Padma* and *C. Ravana*, to *Keyserlingites subrobustus* and to *K. Dieneri*, that the characters of *Keyserlingites* are found in a species, whose inner volutions do not at all agree with *Olenekites*, and that, on the other hand, forms with a widely different external appearance (*Proptychites, Beyrichites*) are linked together most intimately with nodose Ceratites, we must confess that, to arrive at purely monophyletic elements of classification is possible only in very exceptional cases.

Regarding a classification, therefore, based on purely monophyletic elements as a *pium desiderium*, which cannot be fulfilled for the moment, I have accepted the genus

Ceratites in the old circumscription as a polyphyletic genus, composed of different elements, with different roots. Not wishing to supplement observed facts by theoretical anticipations, I believed it to be more judicious to leave all the forms hitherto described as *Ceratites* in this genus and to make no generic distinction based on supposed lines of developmental connection. But in order to facilitate a review of the very large number of forms, I have united them in sub-genera, containing such species as are allied by remarkable proper characters. Thus, several of the former *groups* have been elevated to the rank of sub-genera. To these more groups have been added, distinguished from the rest by essential characters. For the distinction of those sub-genera use has been made of the generality of features, not of the development of a single character. This classification of *Ceratites* therefore differs considerably from that introduced in the classification of the *Meekoceratidæ* of the Salt Range by Waagen, founded on one subordinate character, the development of the auxiliary series only.

The most important section is the group of *Ceratites nodosi*. As it includes *Ceratites nodosus* v. Schloth., the prototype of the genus, the name *Ceratites s. s.* must be applied to that section.

Nodosi

Beyrich (Ueber einige Cephalopoden aus dem Muschelkalk der Alpen, etc., Abhandl. Kgl. Akad. d. Wissensch., Berlin, 1866, No. 2, p. 121) was the first author who proposed this group of *C. nodosi*, in which both German and Alpine representatives of the genus were included. I quote Beyrich's own diagnosis of this section:

"The name of *nodosi* is chosen for a group in which the two series of *Ammonites nodosus* and of *A. binodosus* ought to be united. This section contains Ammonites with discoidal shell with a siphonal area, which is always marked off from the lateral parts, distinguished by their strongly-developed sculpture. This siphonal area is not carinate but provided with spines or pinacles along its margins, which correspond to the lateral folds. The folds are dichotomous in adolescent and middle stages of growth. A row of spines or tubercles along the middle of the flanks marks the point of bifurcation. A third accessory row of tubercles or spines may be developed along the umbilical margin. This is a pattern of sculpture strongly recalling that of *Ammonites dentati* in geologically younger systems. As in all other patterns of ornamentation, variations may be noticed in old age. Even smooth forms may result from an obliteration of the sculpture. In *Ammonites nodosus* the dichotomous folds are transformed into single, bulky ribs after the disappearance of the lateral tubercles. In other species all tubercles are obliterated and the ribs replaced by falciform plications or striæ. The complication of the sutural line is restricted to the development of simple indentations at the base of the lobes, but eventually the margins of the saddles and even their tops may be affected by denticulations. In no case, however, are those indentations transformed into denticulate digitations or ramifications by secondary incisions."

From this diagnosis it is evident, that Beyrich united the Alpine group of *Ceratites binodosus* and the German group of *C. nodosus* in his section of *nodosi*. Beyrich's view has been followed by myself in 1895, by Waagen in 1896 and by

Philippi in 1901. E. v. Mojsisovics in 1882, emphasizing the remarkable differences between the majority of Alpine and German Ceratites, separated the Alpine forms from the section of *nodosi* and grouped them into the three developmental series of *Ceratites binodosus*, *C. Zoldianus* and *C. cimeganus* Philippi, in his beautiful memoir quoted above, demonstrated the small importance of the characters of distinction between those three series and the German *nodosi* and he consequently insists on retaining Beyrich's original diagnosis of the section. The evidence of a close affinity of the two series of *Ceratites binodosus* and of *C. nodosus* is one of the chief results of Philippi's careful studies. The introduction of a new sub-generic denomination (*Paraceratites*) for the Alpine group of *C. binodosus* is therefore not justified. *

In accordance with Beyrich and Philippi, I have united both Alpine and German forms in the section of *nodosi*, for which, according to the rules of palæontological nomenclature, the name of *Ceratites s. s.* must be reserved.

To this section of *nodosi* four Himálayan species have been attributed by myself in 1895, namely, *Ceratites Thuilleri* Oppel, *C. himalayanus* Blanf., *C. Kamadeva*, *C. Kuvera*. Philippi (l. c. p. 92) is not inclined to follow my view. He only considers *C. himalayanus* as a typical representative of the *nodosi*, and proposes to include the three other species in the section of *circumplicati* rather than of *nodosi*. To this treatment of the group I am, however, obliged to object.

The most typical representative of the Alpine series of *C. binodosus* in the Muschelkalk of the Himálayas is certainly *Ceratites Thuilleri* Oppel. A. v. Krafft has discovered intermediate forms between this species and *C. trinodosus* v. Mojs. In the shape of the area, in its sculpture, and in the arrangement of its sutural line it differs from the Indian *circumplicati* quite as strongly as *C. himalayanus*. I must confess that I cannot understand the reasons for Philippi's comparing the sutures of *C. Thuilleri* to those of species of the Indian *circumplicati*. *C. Thuilleri* has a narrow auxiliary lobe, which is followed by a high auxiliary saddle. This is an arrangement of sutures similar to that in *C. trinodosus* and differing from that in the most typical forms of the group of *C. Voiti* in the section of *circumplicati*. A similar remark applies to *C. Kuvera*, which is also connected with *C. Thuilleri* by intermediate forms. The last species, *C. Kamadeva*, is so nearly allied to *C. subnodosus* Mojs., that it cannot be placed in another section of the genus to this Alpine species. The differences between *C. Kamadeva* and *C. nodosus*, enumerated by Philippi, exist also between *C. subnodosus* and *C. nodosus*. If Philippi has not considered them sufficiently important to exclude *C. subnodosus* from the section of *C. nodosi*, they certainly offer no evidence against leaving *C. Kamadeva* in that section.

Notwithstanding Philippi's remarks to the contrary, I feel consequently obliged to retain my classification of Himálayan Ceratites and to leave the four species mentioned above in the section of *nodosi*, viz., in the sub-genus *Ceratites s. s.*

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* It is questionable, whether Kittl has acted according to the rules of palæontological nomenclature, in proposing the sub-generic denomination of *Paraceratites* in 1903 (Abhandl., K. K. Geol. Reichsanst., XX, Bd. Hft. 1, p. 29) for a species from the lower Trias of Dalmatia.

To those four species seven more must be added after the examination of the recently acquired Himálayan materials. The typical *Ceratites trinodosus* Mojs. is among them, together with two other species nearly allied to Alpine types (*C. superbiformis*, *C. sp. ind. ex aff. Abichi*). One of the new species exhibits a remarkable external resemblance to *C. atavus* Phil. of the German group of *C. nodosus*, but its inner volutions being unknown to me, I cannot say whether this is a case of convergence only or of real affinity. This question is the more difficult to decide, as a very remarkable convergence actually exists in the shape of the outer volutions of some species of Indian and German *Ceratites nodosi*.

Beyrich remarks that in full-grown individuals of *Ceratites nodosus* the dichotomous folds are often transformed into simple, bulky ribs after the disappearance of the lateral tubercles. The illustrations of *C. evolutus* given by Philippi on Pl. XLII and XLIII of his memoir, clearly show this pattern of sculpture. It only needs a glance at my figures of *C. truncus* and *C. Devasena* to convince the reader of the absolute identity of the sculpture in these two groups of Ammonites. That this is no case of real affinity but of convergence only, is evident from a comparison of the sutures, which differ considerably, especially in the character of the auxiliary series. But with fragments of body-chambers only available for examination, one might, indeed, be at a loss how to distinguish them.

Philippites Diener

A small group of Ceratites, which presents itself as a natural subdivision, consists of *Ceratites Erasmi* v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., Bd. X, p. 43, Taf. XL, fig. 13), *C. aster* v. Hauer (Denkschr. Kais. Akad. d. Wissensch., LIX, p. 262, Taf. III, fig. 3) and *C. tuberosus* v. Arthaber (Beitræge zur Geol. u. Palæont. Oesterr.-Ungarns, etc., Bd. X, p. 58, Taf. V, fig. 6).

All those species are provided with short, spiniplicate ribs, originating from stout umbilical bumps and gradually dying out towards the siphonal margin. It is probably the brachyphyllic development of the sutures which induced Philippi (l. c. p. 87) to unite this little group with *Beyrichites* Waagen. But the sculpture of *Beyrichites* differs considerably from that of the four above-quoted species, consisting of falciform folds, which are always less strongly developed in the lower than in the upper portion of the flanks. If tubercles or spines exist, they are invariably found in the middle of the lateral parts, not in the vicinity of the umbilicus. The absence of any umbilical sculpture is a feature so characteristic of typical representatives of *Beyrichites* (*B. reuttensis* Beyr., *B. Khanikofi* Oppel, *B. affinis* Mojs.), that any attempt to amalgamate spiniplicate forms with this genus must be discarded.

For the accommodation of the four above-quoted species of *Ceratites*, the subgenus *Philippites* may be proposed.

In the Indian Muschelkalk this sub-genus is probably represented by *Ceratites sp. ind. aff. Wetsoni* (Diener l. c., p. 8, Pl. I, fig. 3) from the Shalshal cliff. This species is closely allied to *C. Erasmi*, but its sutures are simpler, the marginal walls of the saddles remaining entire. Whether there exists a closer affinity between this species and *C. Wetsoni* Oppel, cannot be ascertained. *C. Wetsoni* has been founded on a very imperfect fragment, the systematic position of which is rather doubtful. In the sutural line a very broad second auxiliary lobe is the most conspicuous element. In the fragment from the Shalshal cliff the umbilical margin is wanting and the sutural line can only be examined as far as to the first auxiliary saddle.

A typical representative of the sub-genus *Philippites* in the Muschelkalk of the Himálayas is *Ph. Jolinkanus*, which agrees with the Alpine species in its spiniplicate sculpture and in the shape of the narrow area, but differs by less strongly serrated sutures.

Apleuroceras Hyatt

From *Philippites* a species must be kept separate, which has been described as *Dinarites connectens* by E. v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, l. c. p. 9, Taf. III, fig. 10) from the Werfen beds of Hungary, notwithstanding its remarkable similarity in sculpture. But in *Dinarites connectens*, which is provided with two lateral lobes as in *Ceratites*, the development of sutures is exactly the same as in typical *Dinarites*. The lobes are few in number, narrow, not serrated, and are separated by very broad, rounded saddles. I think that *Dinarites connectens* might find its systematic position with *Apleuroceras* Hyatt rather than with any other group of *Ceratites*.

Gymnotoceras Hyatt

A group of Arctic Ceratites, which is nearly allied to the *nodosi*, is the section of *Ceratites geminati* v. Mojs. It is distinguished from the *nodosi* by the presence of true keels and of parabolic ears and deserves a special sub-generic designation. An American representative of this section having been described as *Gymnotoceras* by Hyatt we shall follow that learned author in making use of this denomination.

There is only a single species of this sub-genus from the Himálayan Muschelkalk known to me. It has been illustrated in fig. 3, pl. V, of my memoir on the Cephalopoda of the Muschelkalk (Himálayan Fossils, Palæont. Indica, ser. XV, Vol. II, Pt. 2), but has not been distinguished by a specific name, on account of its incomplete state of preservation. The presence of parabolic ears does not permit its identification with the group of *Ceratites rusticus* v. Hauer, as has been advocated by Philippi (l. c. p. 94). The second species, which I have referred to *Gymnotoceras* provisionally and with great reserve only, is too fragmentary to allow of a safe determination.

Halilucites Diener

A third group of forms nearly allied to the section of *nodosi*, consists of carinate Ceratites allied to *Ceratites rusticus* Hauer (Denkschr. Kais. Akad. d. Wissensch., Bd. LXIII, 1896, p. 259, Taf. IX, fig. 1–4) from the Bosnian Muschelkalk of Haliluci. This section, for which I propose the sub-generic name of *Halilucites*, is distinguished by the presence of strong keels, accompanied by siphonal furrows.

In my memoir on the Triassic Cephalopoda of the Bakony (Palæontologischer Anhang zu dem ersten Teil des ersten Bandes der Resultate der wissenschaftlichen Erforschung des Balatonsees, p. 9) I have objected to F. v. Hauer's view that those species should be looked upon as intermediate shapes between *Ceratites* and *Hungarites*. *Hungarites*, which makes its first appearance together with *Otoceras* in the Permian rocks of Djulfa, entirely agrees with *Otoceras* in its development, exhibiting a tripartite character of the siphonal part in adolescent stages of growth. The siphonal part is roof-shaped, its two flanks sloping regularly from a sharp median keel or edge towards the marginal ridges. In *Otoceras*, which is most intimately related to *Hungarites*, from which it differs only by the ear-shaped expansion of its umbilical margin, I have been able to trace this tripartite character of the siphonal part in young specimens with a diameter of the shell of only 5 mm. In old age the three-edged termination of the siphonal part becomes obsolete, the marginal edges disappearing gradually, whereas the sharp, knife-like median edge remains. In such full-grown individuals the transverse section is helmet-shaped.

From this typical shape of *Hungarites* and of *Otoceras* the Bosnian Ceratites of the group of *Ceratites rusticus* differ considerably. Their siphonal part is raised into a high median keel, but is not roof-shaped. The keel is not sharpened into an acute edge, but is often rounded along its top and bordered by deep marginal furrows. In *Halilucites* the slope between the siphonal and marginal ridges is always interrupted in a very remarkable manner. This is a good feature of distinction between *Halilucites* and *Hungarites*.

In the Indian Muschelkalk a single species of *Halilucites* is known to me. It is nearly allied to *H. planilateratus* v. Hauer from the Bosnian Muschelkalk.

The most important group of Indian Ceratites is the section of *circumplicati*, for which I propose the sub-generic designation of *Hollandites*.x' Philippi considers this group as remarkably well defined and in his diagnosis (l. c. p. 93) ennmerates the following features as its leading characters of distinction :—

Hollandites Diener
1905.

" Diener's *circumplicati* are forms with closely-set ribs, which, as a rule, are slightly falciform. In the chambered parts of the shell the ribs are often dichotomous, bifurcation occurring either in the region of lateral tubercles or near the umbilical margin. Umbilical tubercles are developed in the majority of species, lateral and marginal tubercles, however, less frequently. This is a difference between Diener's *circumplicati* and the section of *binodosi*, in which lateral and marginal tubercles make their appearance first and are followed by umbilical tubercles in some species only and in considerably later stages of growth.

" In their sutures the Indian *circumplicati* also differ remarkably from the overwhelming majority of European representatives of the genus *Ceratites*. In the Indian *circumplicati* one character of their sutures is very conspicuous and constant: this is the small number and high development of principal elements. Besides the median prominence three saddles only are constantly and well developed, namely, the siphonal and two lateral saddles. Of auxiliary elements the first auxiliary lobe alone is distinctly marked. All the remaining elements are rudimentary and very inconstant in shape and number. Those auxiliary elements between the first auxiliary lobe and the umbilical suture correspond exactly to the auxiliary indentations of the *nodosi*. In Diener's *circumplicati* consequently one principal element of the sutural line of *nodosi*, a distinctly developed first auxiliary saddle, is entirely

x' Entwurf einer Systematik der Ceratitiden des Muschelkalkes. Sitzungsber. K.K. Akad. Wiss. Wien. (Math. Nat. Kl), Bd. CXIV, I Abth. (1905), p. 776

Hollandites Diener

absent. This is the more remarkable because the Indian *circumplicati* are mostly large and not strongly evolute forms.

"With this comparatively small number of principal sutural elements their complicated development is in contrast. In nearly all species the saddles are serrated up to their tops. I am bound to confess, that the arrangement of sutures in Indian *circumplicati* reminded me of *Trachyceras* rather than of *Ceratites*."

I have quoted Philippi so far, but I am sorry to say, I cannot agree with him on all essential points of his diagnosis of Indian *circumplicati*, my examination of very rich materials having led me to different results.

The most important external feature, and constant in all species of *Hollandites*, is the predominance of ribs and the comparatively insignificant part which tubercles play in the ornamentation. Two different developmental series may be distinguished. In the first, to which the majority of species belongs, the sculpture is but faintly marked in the inner nuclei and gradually increases in strength and complication towards the body-chamber whorl. The simplest types of this group are *Hollandites Visvakarma* and *H. Roxburghii*, in which the sculpture consists of straight radiating ribs only, without any tubercles. The most highly developed forms are *H. Voiti* and *H. Ravana*, in which the ribs are often dichotomous and adorned with umbilical, lateral and marginal tubercles.

In the second group are included those forms of which the lateral sculpture is most strongly developed in the inner nuclei and gradually dies out towards the peristome. *Hollandites Airavata*, *H. Cecilii* and *H. Moorei* belong to this group. *H. Airavata* is provided with umbilical tubercles. In the two other species tubercles are altogether absent.

Philippi's suggestion that umbilical tubercles invariably make their appearance before the lateral and marginal ones, is not in accordance with the results of my examination of young individuals of *Hollandites Ravana var.* in which umbilical and lateral tubercles appear together in the same stage of growth. In *H. Dungara* no umbilical tubercles at all are developed, but only protracted lateral elevations and siphonal prominences of the ribs in the outer volutions.

Special stress has been laid by Philippi on the character of the sutural line of *Hollandites*, especially on the absence of a distinctly marked first auxiliary saddle. This argument has also proved to be insufficient on closer examination of my Himálayan materials. Two species, which in their external shape and sculpture must be considered as typical representatives of this sub-genus, *H. Visvakarma* and *H. Moorei*, are provided with auxiliary saddles as distinct as in any species of the section of *nodosi*. To them a third species, previously described as *Meekoceras Nalikanta*, must be added, which I prefer to include now in the sub-genus *Hollandites*. Although the character of the sutural line described by Philippi is well marked in *H. Voiti* and its allies, it cannot be looked upon as a feature of sub-generic importance common to all Indian *Ceratites circumplicati*.

As Waagen's important studies of the fauna of the Salt Range Ceratite formation had not yet been published at the time when I wrote my memoir on the

Cephalopoda of the Himálayan Muschelkalk, I accepted the genus *Meekoceras* in the wide interpretation in which the name had been applied by E. v. Mojsisovics. Three species, which I thus originally included in the genus *Meekoceras*, namely, *M. Nalikanta*, *M. Srikanta* and *M. Narada*, were subsequently included in Waagen's genus *Proptychites*. The examination of inner nuclei of *Hollandites Voiti* Oppel and the discovery of a species most intimately allied to *Meekoceras Nalikanta*, *viz.*, *Hollandites Cecilii*, have convinced me that their proper systematic position is probably among the representatives of *Hollandites*.

Some very remarkable cases of convergence have been noticed between adult individuals of several species of the sections of *Ceratites nodosi* and *circumplicati*. There are species in both sections with a tendency to change the sculpture of the inner volutions in the body-chamber whorl. The ornamentation of the latter consists of simple, distant and coarse radial ribs, which are never dichotomous and strongly recall the sculpture in the outer volutions of the typical *Ceratites nodosus* from the German Muschelkalk. Outer volutions with this pattern of sculpture are found in species whose inner whorls are entirely different, *e.g.*, in *Ceratites Devasena* or in *C. truncus* of the section of *nodosi*, and in *Hollandites Vyasa* of the section of *circumplicati*.

Another remarkable case of convergence is afforded by the outer volutions o *Ceratites Padma* and of *Hollandites Ravana*, which in their ornamentation cannot be distinguished, although the inner nuclei of the two species are entirely different.

From such experience it is evident that outer volutions of Indian Ceratites, separated from their inner nuclei, become practically indeterminable I have, indeed, been obliged to leave undetermined a large number of fragments collected in the Muschelkalk of Spiti by Hayden and A. v. Krafft, which formerly would have been referred without hesitation to *Ceratites Vyasa* or to *C. Ravana*.

It is consequently impossible to establish the systematic position of the fragment which Oppel has thought worthy of the specific name of *C. onustus*, or of *Ammonites Blanfordi* Salter. Those two names must be discarded entirely, having been attributed to undeterminable specimens.

In common with E. v. Mojsisovics I have considered the majority of Indian *circumplicati* as representatives of the Arctic group of *Ceratites polaris* (*Arctoceras* Hyatt), but it must be remembered that this was before the important results of Waagen's examination of the lower Triassic ammonites from the Ceratite formation of the Salt Range were known to me. Waagen (Fossils from the Ceratite formation, Salt Range Foss., Palæont. Indica, ser. XIII, Vol. II, p. 116) pointed out the remarkable similarity between the group of *C. polaris* and his genus *Proptychites*. Philippi (l. c. p. 90) peremptorily excludes *Arctoceras* from the genus *Ceratites* and denies any close relationship between Arctic and Indian *circumplicati*. Having no materials of *Arctoceras* at hand for studying the development of the inner volutions, I am not able to enter further into this question.

Ceratites polaris
ancestor of the
Circumplicati?

Among European Ceratites *C. Petersi* v. Mojs., *C. Zezianus* v. Mojs. and *Ceratites sp. ind.* Diener from the Muschelkalk of the Schiechlinghoehe (Diener,

European species to Hollandites ?

Beitræge zur Geologie und Palæontologie Oesterr. Ungarns, etc., XIII, 1901, p. 11, Taf. II, fig. 5) are probably representatives of the sub-genus *Hollandites.* I cannot agree with E. v. Mojsisovics in placing *C. Petersi,* a near ally of *Hollandites Voiti* Oppel, in the group of *Ceratites binodosus,* since the most important character of that group, the presence of lateral tubercles, is only very indistinctly developed. In the predominance of ribs as principal elements of sculpture *C. Petersi* agrees with the Indian types of *circumplicati.* *C. Zezianus* and *C. sp. ind.* from the Schiechlinghoehe are too imperfectly known to permit a safe establishment of their systematic position.

In the inner nuclei of *Hollandites Vyasa* the lateral ribs are not interrupted along the siphonal area, but pass over it in a nearly straight line without diminishing in size. In the Muschelkalk of Byans a species of *Ceratites* has been discovered by F. H. Smith, in which this character is not restricted to young stages of growth but persists in old age. For the accommodation of this species (section of *Ceratites continui*) the sub-genus *Peripleurocyclus* is proposed.

Peripleurocyclus Diener

In *Peripleurocyclus Smithianus* the ribs are but faintly developed in the umbilical region and reach their maximum strength along the siphonal part. The ribs are simple, not dichotomous. If the pattern of sculpture, peculiar to *Peripleurocyclus,* were combined with the ornamentation of *Philippites Jolinkanus,* forms with the external shape of the genus *Acrochordiceras* Hyatt would result from this combination.

Danubites Mojs.

In 1893 a new sub-genus, *Danubites,* was proposed by E. v. Mojsisovics for the two united groups of *Ceratites obsoleti* and of *Celtites Floriani.* As characters of this new sub-genus slowly-increasing volutions, which scarcely overlap each other, and straight radial ribs are quoted. In my memoir on the Cephalopoda of the lower Trias of the Himálayas (p. 24) I have explained that this sub-genus is largely represented in the lower Triassic deposits of the Himálayas and that two species also occur in the lower Muschelkalk of the limestone-crag of Chitichun. I have laid special stress on the fact that none of the lower Triassic species can be united with the group of *Danubites Floriani* v. Mojs. The advisability of separating the latter group from *Danubites* as a proper sub-genus (*Florianites* Hyatt) might be taken into consideration.

E. v. Mojsisovics in his Cephalopoden der Hallstätter Kalke (Abhandl. K. K. Geol. Reichsanst., VI-1, p. 1, Supplementbd., 1902, p. 323) advocates a generic separation of the Indian forms, united in the sub-genus *Danubites* in my memoirs on Himálayan fossils, from the group of Arctic *Ceratites obsoleti.*

According to his opinion, *Meekoceratidæ* were the ancestors of Indian *Danubites*, and *Dinarites spiniplicati* (*Olenekites*) the ancestors of *Ceratites obsoleti.* The external resemblance of both groups is therefore a case of convergence only, and a classification of ammonites based on the monophyletic principle of phylogeny consequently demands their division into two separate genera. E. v. Mojsisovics therefore restricts the name of *Danubites* to the Arctic species and proposes to unite the Indian forms with Waagen's genus *Xenodiscus.*

I am not inclined to follow this view. Phylogeny is very unsafe ground for palæontological classification. According to my opinion, species agreeing in all essential characters must be united in one genus and cannot be separated merely on the ground of hypothetical affinities to supposed ancestors. To the amalgamation of Indian *Danubites* with *Xenodiscus* Waagen I must particularly object, because *Xenodiscus plicatus* Waagen, the prototype of the genus, differs from all Indian species of *Danubites* by the remarkable length of its body-chamber.

Two very remarkable species of the Himálayan Muschelkalk, *Ceratites Hatscheki* and *C. Oberhummeri*, occupying an isolated position among this genus, are prototypes of the new sub-genera *Haydenites* and *Salterites*. Their leading features will be mentioned in the specific descriptions.

Haydenites Diener

Salterites Diener

Keyserlingites Hyatt

That the developmental connection of the single forms is a very unsafe guide in the classification of *Ceratitoidea*, is most clearly proved by some characters of the Indian types, belonging to the section of *Ceratites subrobusti*. In the Triassic fauna of the Arctic region the section of *C. subrobusti* forms a well-individualised group, so nearly allied to *Dinarites spiniplicati* (*Olenekites*) from the same geological horizon, that E. v. Mojsisovics considered them to be connected by an uninterrupted evolutional series. Philippi removed this section altogether from the genus *Ceratites* and united it in a new genus, *Robustites*. Hyatt's denomination, *Keyserlingites*, introduced for the section of *Subrobusti* in 1900 in the English edition of Zittel's text-book of Palæontology, having the priority, must be accepted according to the rules of palæontological nomenclature.

I shall not enter here into the discussion about the advisability of considering the group of *Ceratites subrobusti* as a genus entirely different from *Ceratites*, which has arisen between Philippi and E. v. Mojsisovics (Cephalopoden der Hallstätter Kalke, l. c. VI—1, Supplementbd., p. 326). E. v. Mojsisovics, strongly insisting on the systematic importance of sculptural elements, lays special stress on the Arctic *Ceratites Bungei* and on the congeneric forms of the Indian Muschelkalk, which, according to his view, prove the absolute coincidence of their pattern of ornamentation with that of the *Ceratites nodosi*.

Having been able to examine in detail some excellently preserved specimens of *Keyserlingites* from the Himálayan Muschelkalk and to make their different developmental stages accessible to observation, I have been led to the conviction that their inner nuclei differ remarkably from those of the Siberian representatives of the group. The peculiar mode of development of the morphological elements of the shell will be explained more thoroughly in the description of *Keyserlingites Dieneri*.

That *Keyserlingites subrobustus* Mojs., the prototype of the sub-genus, and *K. Dieneri* are offsprings from common ancestors, is very improbable, notwithstanding their external similarity, which has even induced me, in accordance with E. v. Mojsisovics, to plead for their specific identity. Even *Keyserlingites*, therefore, if the Indian types were not removed from it would no longer fulfil the fundamental postulate of theorists, that a genus ought to be strictly monophyletic. On the other hand, any grouping of species of ammonites on a morphological basis would become impossible, if species resembling each other so very closely and characterised by similar external features and sutures, were placed in different sections. In the knowledge of the majority of Triassic ammonites the uncertainty about the characters of their inner nuclei is one of the most obscure points. The discovery of specimens in which they might be studied in detail, is an exceptional case only. As far as my experience goes, the time for a classification of ammonites on the basis of developmental connection has not yet arrived.

There is one reason especially which induces me not to remove *Ceratites Dieneri* from the sub-genus *Keyserlingites*. The practical consequence of a generic separation of the Indian and Siberian types would be the impossibility of arriving at a satisfactory determination of any specimen without destroying it. I am no advocate of the requirement of geologists that the distinction of genera should rest only on such peculiarities as are easily accessible to observation in the majority of fossil remains; nevertheless, I think that practical reasons should, indeed, forbid the use of such characters as fundamental points of generic distinction as are only accessible by sacrificing precious material and which in many faunæ of ammonites cannot be observed at all.

Keyserlingites Dieneri Mojs., which in later stages of growth resembles so strongly *K. subrobustus*, is not the only representative of the section of *Ceratites subrobusti* in the Himálayan Muschelkalk. Another species of this group recalls the Arctic *K. Bungei*, a third recalls an unnamed species from the mouth of the Olenek, but both of them are preserved in fragments only and nothing is known of their inner volutions. As far as our knowledge of *K. Dieneri* goes, I am rather inclined to consider these resemblances as cases of a remarkable convergence than of a real phyletic affinity.

Thus, we may leave the Indian representatives of *Ceratites subrobusti* in the sub-genus *Keyserlingites*, but must give up every idea of their direct phylogenetic connection with the congeneric species of the Arctic region. The ancestors of *K. Dieneri* and its allies must almost certainly have differed considerably from *Olenekites*, as may be seen at once from a comparison of the inner nuclei of *K. Middendorffi* in E. v. Mojsisovics' "Arktische Triasfaunen" (Taf. II) and of *K. Dieneri* in this memoir (Pl. XI, fig. 2). It has been suggested by F. Noetling (Lethæa Mesozoica, Vol. I, Pt. 2, p. 157), that there is a great probability of *Ceratites subrobustus* belonging to the genus *Stephanites* Waagen (Ceratite Formation, Palæont. Indica, ser. XIII, Salt Range Foss., Vol. II, p. 100) from the upper Ceratite limestone of the Salt Range. I cannot agree with this view. The sculpture of *Stephanites* differs considerably from that of *Keyserlingites*, consisting, as it does, of very stout tubercles or thorns only, without any intervening ribs. Another difference is noticed in the length of the body-chamber, which is nearly twice as long as in *Keyserlingites*, comprising even more than the entire last volution. I think that Waagen was perfectly right in attributing *Stephanites* to the *Tropitoidea*, not to the *Ceratitoidea*, and considering it as closely allied to *Acrochordiceras* Hyatt.

Thus we arrive at the following classification of the species from the Himálayan Muschelkalk, which might be included in the genus *Ceratites* in a wider range of interpretation :—

A. *Ceratites s. s.* (section of *C. nodosi* Beyr.).
    1. *Ceratites trinodosus* v. Mojs.
    2. „ *Thuilleri* Oppel.
    3. „ *Himalayanus* Blanf.
    4. „ *sp. ind. aff. Abichi* Mojs.
    5. „ *superbiformis* nov. sp.
    6. „ *Kamadera* Dien.
    7. „ *Kuvera* Dien.
    8. „ *Royleanus* nov. sp.
    9. „ *truncus* Oppel.
    10. „ *Devasena* nov. nom.
    11. „ *Padma* nov. sp.
B. *Philippites* (group of *C. Erasmi* Mojs.).
    12. *Philippites jolinkanus* nov. sp.
    13. „ *sp. ind. aff. Wetsoni* Opp. (?).
C. *Gymnotoceras* Hyatt (group of *C. geminati* Mojs.).
    14. *Gymnotoceras sp. ind aff. geminato* Dien.
D. *Halilucites* (group of *C. rusticus* Hauer).
    15. *Halilucites sp. ind. ex aff. planilaterato* Hau.
E. *Hollandites* (group of *C. circumplicati* Dien.).
    16. *Hollandites Voiti* Oppel.
    17. „ *Ravana* Diener.
    18. „ *Airavata* Dien.
    19. „ *Cecilii* Dien.
    20. „ *sp. ind. aff. Cecilii* Diener (Cephalopoda of the Muschelkalk, Pl. IV, fig. 4).
    21. „ *Hidimba* Dien.
    22. „ *Dungara* Dien.
    23. „ *Visvakarma* Dien.
    24. „ *Roxburghii* nov. sp.
    25. „ *Arjuna* Dien.
    26. „ *Moorei* nov. sp.
    27. „ *Vyasa* Dien.
    28. „ *Nalikanta* Dien.
    29. „ *Srikanta* Dien.
    30. „ *Narada* Dien.
F. *Peripleurocyclus* (group of *C. continui* Dien.).
    31. *Peripleurocyclus Smithianus* nov. sp.
G. *Salterites.*
    32. *Salterites Oberhummeri* nov. sp.
H. *Haydenites.*
    33. *Haydenites Hatschekii* nov. sp.
J. *Keyserlingites* Hyatt (group of *C. subrobusti* Mojs.).
    34. *Keyserlingites Dieneri* Mojs.
    35. „ *Pahari* nov. sp.

36. *Keyserlingites sp. ind. aff. subrobusti* Diener (l. c. Pl. V, fig. 6).
37. „ *sp. ind. aff. Middendorffi* Diener (l. c. Pl. V, fig. 7).
38. „ *pagoda* nov. sp.
39. „ *nov. sp. ind. ex aff. Bungei* Mojs.
40. „ *nov. sp. ind.*

K. *Florianites* Hyatt.

41. *Florianites Kansa* Dien.

The systematic position of two species described by Oppel, which have been based on very poorly preserved fragments, *Ceratites Wetsoni* and *C. onustus*, has not been ascertained. The species of *Ceratites*, which has been illustrated as *Ceratites Wetsoni* by Frech in the Lethæa Mesozoica, Vol. I, Pt. 2, "Die Asiatische Trias" (Taf. 16, fig. 3), has nothing whatever to do with Oppel's species. It is a typical representative of the group of *nodosi*, probably nearly allied to *Ceratites Thuilleri* Oppel. It only needs a glance at the illustration of Oppel's type-specimen to find out that no affinity whatever exists between this and Frech's specimen from the Silakank. I am at a loss to understand the reasons which led Frech to an identification of two forms differing so remarkably from each other.

Sub-genus: *CERATITES (SENSU STRICTO).*

(*Group of Ceratites nodosi*).

1. CERATITES THUILLERI Oppel.

1863. *Ceratites Thuilleri* Oppel, Palæontologische Mittheilungen aus dem Museum des kgl. bayr. Staates Stuttgart, p. 277, Pl. 77, fig. 3.

1895. *C. Thuilleri* Diener, Himál. Foss. Palæont. Ind., ser. XV, Vol. II, Pt. 2. The Cephalopoda of the Muschelkalk, p. 21, Pl. II, figs. 1, 2.

The present species of *Ceratites* is one of the commonest in Hayden's and A. v. Krafft's collections from Spiti. My specimens, although exhibiting great variability in size, ornamentation and details of their sutural line, agree with the typical form described by Oppel and with the variety from the Shalshal cliff, illustrated in fig. 2 of my above-quoted memoir.

A character, which has been met with in all my examples and may serve as a distinguishing feature between fragments of adult individuals of the groups of *C. Thuilleri* and *C. Voiti* (*Hollandites*), is the square shape of the transverse section. In the group of *C. Voiti* and its allies the ventral area is always rounded and passes very gradually into the lateral parts. In the group of *C. Thuilleri* it is broad, gently-arched and separated more or less distinctly from the flanks. In body-chambers of both groups the sculpture becomes eventually obsolete, being reduced to falciform undivided ribs, without prominent tubercles. In such specimens I have invariably found the shape of the transverse section a good character of distinction.

The siphonal area is never carinate, as in *Ceratites himalayanus* Blfd. In old individuals it often becomes perfectly flattened, but in small specimens it occasionally assumes a roof-like shape, its two lateral slopes meeting in a bluntly-rounded angle.

The lateral sculpture is subjected to a greater variability than might have been anticipated from an examination of the materials from the Shalshal cliff collected in 1892. This variability chiefly concerns the relative strength of ribs and tubercles. Both in Oppel's type-specimen and in my examples from the Shalshal cliff the ribs were the predominant element of sculpture, especially so in body-chamber volutions. But in the collections which are before me now, exceptional specimens have been met with, in which the ribs are moderately developed and adorned by strong and high thorns. Especially the lateral and marginal spines are strongly developed, whereas the umbilical tubercles are more faintly marked, as is the case in some varieties of the Alpine *C. trinodosus, e.g.*, in the specimen from the Bakony, illustrated by E. v. Mojsisovics in Abhandl. K. K. Geol. Reichsanst., X, Pl. VIII, fig. 5.

Bifurcation of the ribs originating in umbilical tubercles has but rarely been noticed. In the lateral tubercles bifurcations occur very irregularly but are never entirely absent, not even in the body-chamber volution of full-grown individuals. The number of marginal tubercles is never more than double the number of lateral ones, but usually less than one and a half times that number. A somewhat exceptional type is exhibited by a full-grown specimen from Muth (coll. Hayden), which in its general shape and in the character of the inner volutions agrees completely with Oppel's type-specimen from the same locality. In this specimen 15 ribs are counted rising from umbilical tubercles. Two of those ribs bifurcate in lateral tubercles, whereas all the ribs belonging to the body-chamber of the volution remain undivided. Nevertheless an augmentation of ribs is also noticed in the body-chamber, but by intercalation of two new ones. Thus 19 marginal tubercles correspond to 15 lateral ones, if one may be allowed to call tubercles those faint traces of prominences which interrupt the regular elevation of the ribs in the body-chamber of this specimen. In Oppel's type-specimen a single intercalated rib is developed in the vicinity of the aperture.

The number of ribs is equally variable. In a nearly complete example from the Shalshal cliff, with part of its body-chamber preserved, 19 ribs are counted. In Oppel's type-specimen this number amounts to 23. In a third example from Muth only seven ribs are counted to one-half volution. In specimens provided with a small number of ribs both ribs and tubercles are, as a rule, more strongly developed.

As has been remarked by E. v. Mojsisovics, the involution of the whorls takes place outside the spiral line of lateral tubercles. Only a small number of specimens are sufficiently well preserved to allow an examination of this character, in which they agree with Oppel's type-specimen.

Sutures.—Oppel's type-specimen of *C. Thuilleri* is distinguished by the presence of brachyphyllic sutures, the saddles being serrated up to their tops. This is also the case in some of the specimens collected near Muth by Hayden. In other examples, however, the brachyphyllic development of the sutural line is less clearly marked. In a typical specimen from Muth the tops of the saddles are entire and the marginal walls are but faintly serrated. Nor are the denticulations of the principal lateral lobe so deep and finger-shaped as in Oppel's type-specimen. The sutures of this example do not differ in any respect from these in typical specimens of the Alpine *C. binodosus* Hauer or *C. trinodosus* Mojs.

Locality: number of specimens examined.—Shalshal cliff 1, coll. Krafft; Muth, Spiti, 10, coll. Hayden, 1, coll. Krafft; Thanam valley, Bashahr, 1, coll. Hayden; Jolinka, Byans, 2, coll. Smith; ridge between Dharma and Lissar valleys, 1, coll. La Touche.

2. CERATITES TRINODOSUS v. Mojsisovics. Pl. III, fig. 5.

1882. *Ceratites trinodosus* E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst, X, p. 29, Taf. VIII, figs. 5, 6, 7, 9, Taf. XXXVIII, figs. 6, 7.
1887. *C. trinodosus* v. Hauer, Die Cephalopoden des bosnischen Muschelkalkes von Han Bulog bei Serajevo Denkschr. Kais. Akad. d. Wiss, LIV, p. 26.
1896. *C. trinodosus* F. v. Hauer, Nautiliden und Ammoniten mit ceratitischen Loben aus dem Muschelkalk von Haliluci bei Sarajevo, Denkschr, Kais. Akad. d. Wiss, LXIII, p. 252.
1896. *C. trinodosus* G. v. Arthaber, Die Cephalopoden fauna der Reiflinger Kalke, Beitræge zur Geol. u. Pal. Oesterr,Ungarns, etc. X, p. 48, 197, Taf. IV, fig. 3, XXIII, fig. 1.
1899. *C cf. trinodosus* A. v. Krafft, General Report, Geol. Surv. of India for 1898-99, p. 18.
1900. *C. trinodosus* Diener, Die triadische Cephalopodenfauna der Schiechlinghoehe bei Hallstätt, Beitræge zur Geol. und. Pal. Oesterreich-Ungarns, etc. XIII, p. 6.
1900. *C. trinodosus* Diener, Neue Beobachtungen ueber Muschelkalk Cephalopoden des suedlichen Bakony Palæontologischer Anhang des ersten Bandes der Resultate der Wissenschaftlichen Erforschung des Balatonsees, I, p. 4.

A. von Krafft was the first to mention the presence of transitional shapes between *Ceratites Thuilleri* Oppel and *C. trinodosus* v. Mojs. in the Himálayan Muschelkalk and emphasized the identification of a specimen from Hayden's collection with the well-known species of the Alpine Muschelkalk. His interpretation of the illustrated specimen, which is lying before me, has been proved to be entirely correct.

As characters of distinction between *Ceratites Thuilleri* and *C. trinodosus* the following have been enumerated: the smaller number of marginal tubercles corresponding to umbilical and lateral ones in *C. Thuilleri*, the involution of the whorls outside the spiral line of lateral tubercles, the brachyphyllic character of the saddles in the sutural line.

The first character may serve to distinguish *Ceratites Thuilleri* from *C. trinodosus* but not from *C. binodosus* v. Hauer, which, according to the diagnosis given by E. v. Mojsisovics, differs from some varieties of *C. trinodosus* by the smaller number of marginal tubercles only. The two Alpine species are, indeed, linked together so intimately by transitional shapes, that their distinction becomes rather arbitrary. The brachyphyllic character of the sutural line has not been noticed in all specimens of *C. Thuilleri* as a constant feature. In the preceding description examples from the Muschelkalk of Muth have been mentioned which in their sutural line agree entirely with *C. trinodosus*. Thus the difference in the mode of involution seems to be the most important and leading character of distinction between the two species.

A. v. Krafft in his preliminary report on Hayden's collections from the Muschelkalk of Spiti remarks the presence of a specimen from Kágá, which to him appeared more nearly allied to *C. trinodosus* than to *C. Thuilleri*. It is the specimen illustrated in fig. 5, Pl. III. From an examination of this specimen it is obvious that the involution of the whorls takes place *inside*, not outside, the spiral line of lateral, tubercles. Thus the present example agrees with *C. trinodosus*, not with *C. Thuilleri*, in its most important character of distinction. In its sculpture it recalls the Lombardic variety of *C. trinodosus* or even of *C. binodosus* by the faint development of umbilical tubercles. It is difficult to fix the number of marginal tubercles accurately, but it seems to be more than twice the number of lateral ones. At the beginning of the last volution three marginal tubercles repeatedly correspond to one umbilical tubercle. Near the aperture the proportion of lateral to marginal tubercles is 1 : 2.

Dimensions.—The specimen having been partly deformed by crushing, the measurements have been taken one-quarter of a volution behind the aperture.

Diameter of the shell	57 mm.
„ „ „ umbilicus	12 „
Height of the last volution	27 „
Thickness „ „ „	23 „

Sutures.—Nearly one-half of the last volution belongs to the body-chamber. Sutures agreeing with those of *C. trinodosus*. Lobes with narrow denticulations, saddles with entire tops. Two auxiliary lobes outside the umbilical margin.

Remarks.—I cannot find any reason for separating this specimen from the Alpine *C. trinodosus* v. Mojs.

A second example from Muth (coll. Hayden) also very strongly recalls *C. trinodosus* by its involution, which corresponds exactly to the spiral line of lateral tubercles, but is not sufficiently well preserved to allow of accurate determination.

3. CERATITES sp. ind. aff. ABICHI v. Mojs.

1899. *Ceratites aff. Abichi* A. v. Krafft, General Report, Geol. Surv. of India, 1898-99, p. 18.

A poorly-preserved fragmentary cast of an ammonite from the Muschelkalk north-north-west of Kágá, Spiti (coll. Hayden), recalls *Ceratites Abichi* v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst. X, p. 21, Taf. XI, fig. 8, Taf. XXII, fig. 6, Taf. XXXIII, fig. 7) and *C. binodosus* v. Hauer (Denkschr. Kais. Akad. d. Wiss., 1850, Bd. II, p. 114, Taf. XIX, figs. 1, 4).

The number of ribs and tubercles is larger than in *C. binodosus*. About twenty marginal tubercles are counted to one-half volution, whereas in full-grown individuals of *C. binodosus* the greatest number is 24 in one entire volution. In the number of ribs this specimen agrees better with *C. Abichi*, especially with the example from the Schreyer Alpe illustrated in Pl. XXII, fig. 6, by E. v. Mojsisovics. It is, however, easily distinguished from *C. Abichi* by the development of stout marginal tubercles. In *C. Abichi* true marginal tubercles are absent and are replaced by irregular bumps.

The specimen is not fit for illustration and is too badly preserved to admit of exact determination. But it certainly belongs to a new species and is not identical with either *C. Abichi* or *C. binodosus*.

4. CERATITES cf. KAMADEVA Dien.

1895. *Ceratites Kamadeva* Diener, Himálayan Foss., Palæont. Indica, ser. XV, Vol. II, Pt. 2. The Cephalopoda of the Muschelkalk, p. 24, Pl. V, fig. 1.
1899. *C. cf. Kamadeva* A. v. Krafft, General Report, Geol. Surv. of India for 1898-99, p. 18.

A poorly-preserved fragment of the outer volution of a large *Ceratites* from Muth (coll. Hayden) is probably identical with *C. Kamadeva* Diener from the Muschelkalk of the Shalshal cliff.

There is no Alpine species to which the present one is as nearly allied as to *Ceratites subnodosus* v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl., K. K. Geol. Reichsanst, X, p. 33, Taf. X, figs. 9-11): An examination of the rich Muschelkalk fauna of the Schiechlinghoehe near Hallstatt has led to the discovery of a large example of *Ceratites subnodosus*, which resembles very closely the type-specimen of *C. Kamadeva* from the Shalshal cliff. In both species the difference of the radial sculpture outside and inside the spiral line of lateral tubercles is the most prominent element of ornamentation. Notwithstanding the differences in their external shape, involution and sutures, *C. Kamadeva* should, I think, be considered as an Indian representative of the Alpine *C. subnodosus*.

According to Philippi's opinion the affinity of *C. subnodosus* to the German representatives of the group of *nodosi* is less close than had been suggested by E. v. Mojsisovics. *Ceratites nodosus* and its allies are provided with lateral tubercles in their juvenile stages, not with umbilical ones, as in *C. subnodosus* or *C. Kamadeva*.

5. CERATITES SUPERBIFORMIS nov. sp. Pl. III, fig. 4.

1899. *Ceratites aff. superbus* A. v. Krafft, General Report, Geol. Surv. of India for 1898-99, p. 18.

This beautiful species is represented in the Himálayan collection by a fairly well preserved specimen from Muth, Spiti (coll. Hayden), consisting of air-chambers only, and by an incomplete example from the ridge between the Dharma and Lissar valleys, Kumaon (coll. La Touche), with parts of its body-chamber preserved. The illustrated example from Muth is to be considered as prototype of the species.

In its outlines and sculpture this specimen exhibits a striking similarity to *Ceratites superbus* v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl., K. K. Geol. Reichsanst, X, p. 32, Taf. XXVIII, fig. 10, Taf. XXXIII, figs. 5, 6) from the Muschelkalk of the Schreyer Alpe. It is especially to the example of similar size illustrated in fig. 6, Pl. XXXIII, by E. v. Mojsisovics, that it appears most nearly allied. The contrast in the ornamentation of the lower and upper parts of the flanks is as strongly marked as in the Alpine type. The lower part is adorned with umbilical tubercles only, from which very short radial ribs originate. The upper portion is covered with numerous straight ribs, connecting distinctly developed lateral and marginal tubercles. In a broad spiral zone below the lateral tubercles the sculpture is entirely interrupted.

In their general outlines and involution the two specimens from Muth and from the Schreyer Alpe also agree. Nevertheless, there are sufficiently good reasons for considering the Himálayan example the prototype of a proper species.

The most remarkable difference between the Indian and Alpine forms is the character of the siphonal parts. This is very flatly arched in C. *superbus* and marked off sharply from the flanks by the rows of marginal tubercles. Thus the transverse section is nearly rectangular. In the Himálayan species the siphonal part is highly vaulted, and, in the inner volutions, even elevated into an indistinct keel. Nor do the marginal tubercles form a sharply-marked border between the flanks and the siphonal part. The transverse section of the aperture is lanceolate, not rectangular.

In the sculpture slight differences between the two species are also noticed.

As in *C. superbus*, the number of lateral tubercles exceeds that of umbilical ones in my Indian specimen, but the proportion of umbilical and lateral tubercles is not the same in both species. In full-grown examples of *C. superbus* three lateral and marginal tubercles are counted to one umbilical tubercle. In *C. superbiformis* the number of lateral tubercles is not even twice as large than that of umbilical ones. The contrast in number between the umbilical and lateral tubercles, which is very striking in *C. superbus*, is, therefore, but faintly marked in *C. superbiformis*.

Another character of difference consists in the presence of short, strongly-forward-turned ribs in *C. superbiformis*, which originate from the marginal tubercles and cross the marginal region of the siphonal part, whereas the siphonal area is entirely smooth in *C. superbus*.

All those characters, by which our species differs from *C. superbus*, are noticed in *Ceratites elegans* v. Mojsisovics (l. c. p. 31, Taf. IX, figs. 5, 6). Nevertheless the affinity to *C. elegans* is certainly less close than to *C. superbus*, whose Indian representative is probably *C. superbiformis*.

Dimensions.

Diameter of the shell	74 mm.
" " " umbilicus	16 "
Height of the last volution { above the umbilical suture	35 "
{ " " preceding volution	25 "
Thickness of the last volution	22·5 "

My second specimen, with a diameter of 80 mm., is provided with a part of its body-chamber, to which nearly one-half of the last volution belongs. Near the aperture the siphonal area gets somewhat flattened, but the siphonal margins remain evenly rounded. In the body-chamber volution the number of lateral tubercles is twice as large as that of umbilical ones. The ribs connecting the lateral and marginal tubercles are not perfectly straight, as in the type-specimen, but slightly falciform.

Sutures.—The sutural line of this species is chiefly distinguished by the striking contrast in the development of the normal and auxiliary elements. The second lateral saddle is followed by a broad, zigzag umbilical lobe, in which auxiliary lobes and saddles can scarcely be separated. Siphonal saddle elongated, slender, considerably higher than the principal lateral saddle and with faintly-serrated margins. Lobes with deep indentations.

The siphonal lobe is not entirely known to me.

6. CERATITES ROYLEANUS nov. sp. Pl. IV, fig. 1.

A fragmentary specimen from the Muschelkalk of the Shalshal cliff (coll. Krafft), consisting almost exclusively of the body-chamber, is especially interesting in consequence of its affinity with a species of the group of *Ceratites nodosi* from the German Muschelkalk. It has the sculpture of *C. binodosus* v. Hauer and in its external characters very strongly recalls *C. atavus* Philippi (Die Ceratiten des oberen deutschen Muschelkalkes, Palæont. Abhandl. von Dames und Koken, Bd. VIII, 1901, p. 49, Taf. XXXIV, fig. 1-4). There is, indeed, no Alpine species to which it might advantageously be compared.

In its dimensions my Himálayan specimen agrees with the example from Ronneberg illustrated in fig. 4 by Philippi (*Ceratites sp. ex aff. C. atavi*), but in its involution it rather recalls the typical form of *C. atavus*. The whorls overlap one another considerably. Transverse section very high. Siphonal area moderately arched. Lateral parts almost perfectly flat, separated from the perpendicular umbilical wall by a sharp edge.

The sculpture consists of small, acute spines only, which are arranged unsymmetrically on both sides of the shell. Both lateral and marginal spines are developed, but no umbilical ones. The number of marginal spines is a little less than twice that of the lateral ones, but is much smaller than the number of corresponding spines in *C. atavus* or in *C. binodosus* v. Hauer. In comparison with the overwhelming majority of *C. nodosi* the ornamentation is very faintly developed. Of ribs insignificant traces only have been noticed.

The shell, which has been partly preserved, is covered with numerous, very delicate and slightly falciform striæ of growth. This falciform character of the striation, together with the faintly developed sculpture, recalls the genus *Beyrichites* Waagen. *Beyrichites Beneckei* v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl., K. K. Geol. Reichsanst, Bd. X, p. 216, Taf. XXVIII, fig. 1, Taf. LXI, fig. 2-4) somewhat resembles our Indian type, especially the example from San Rocco, which has been described by Tornquist (Zeitschr. d.

Deutsch. Geol. Ges. 1898, Taf. XX, fig. 2), but any closer comparison with *Beyrichites* is excluded by the presence of acute spines in the Himálayan form, such as have never been noticed in any species of *Beyrichites* and exhibit the arrangement peculiar to the group of *C. binodosus.*

Dimensions.

Diameter of the shell		70 mm.
„ „ „ umbilicus		13 „
Height of the last volution	above the umbilical suture	33 „
	„ „ preceding whorl	23 „
Thickness of the last volution		20 „

Sutures.—Not known.

Remarks.—*Ceratites atavus*, according to Philippi, is among the German representatives of the section of *nodosi*, the species most nearly allied to the Alpine *C. binodosus.*

As my Himálayan specimen does not, unfortunately, allow of an examination of more than the body-chamber, it is impossible to say whether or not there exists a real affinity between the German and Indian species. That they are not identical is, however, certain, the number of spines being remarkably reduced in *C. Royleanus.*

From *Ceratites vicentinus* Tornquist (l. c. p. 671, Taf. XX, fig. 1), which is quoted by Philippi as very nearly allied to *C. atavus*, our species differs by the absence of ribs and by the smaller number of spines. Of all Ceratites known to me, it recalls *C. atavus* most strongly in its general shape and sculpture.

7. CERATITES TRUNCUS Oppel. Pl. IV, figs. 2, 3.

1865. *Ammonites truncus* Oppel.[*] Palæontologische Mitteilungen aus dem Museum des Kgl. bayrischen Staates, p. 292, Pl. 86, fig. 3.

1895. *Ceratites truncus* Diener, Himálayan Fossils, Palæont. Indica, ser. XV, Vol. II, Pt. 2. The Cephalopoda of the Muschelkalk, p. 26, Pl. I, fig. 7.

Oppel's type-specimen from Kuling, Spiti (coll. Schlagintweit) is the fragment of an outer whorl consisting of four air-chambers only. In Hayden's collections from the Muschelkalk of Kágá, Muth and Kuling several examples have been noticed, the outer whorls of which agree entirely in their sculpture and sutural line with Oppel's type-specimen. In order to retain Oppel's name I have made use of it for these specimens, although a direct identification of any species with a fragment of such small dimensions is rather risky.

The outer volution, part of which belongs to the body-chamber in one of my specimens only, exhibits a sculpture exactly alike that in Oppel's type-specimen.

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[*] The original name of this species was *Ammonites horridus*, but in some copies of the publication this name has been changed into *A. truncus* printed on labels stuck on to hide the former name. On the labels attached to the type-specimen the name *horridus* has been corrected into *truncus* by Oppel himself. I consequently prefer to adopt this latter denomination.

The lateral parts are provided with strong and simple radial ribs, which begin near the umbilical margin as faintly-marked folds and terminate near the siphonal margin in very stout and prominent tubercles. If perfectly preserved, those tubercles are sharpened into acute spines. A second row of lateral tubercles is situated either in the middle or between the middle and the lower third of the flanks. The lateral tubercles are rather variable in their shape, either knob-like or transversely elongated and then forming merely a prominent elevation of the rib. Between the lateral and marginal tubercles there is always a zone of depression affecting the general height of the ribs.

As a rule this sculpture is most prominent at the beginning of the last volution but gradually decreases towards the body-chamber. The lateral tubercles especially become obsolete and lose their knob-like shape, being turned into mere elevations of the ribs. The marginal tubercles, however, persist throughout the entire length of the shell. To a median plane through the siphonal area the ribs always stand more or less asymmetrically. The ribs themselves are roof-shaped and separated by intervals, the transverse sections of which form regularly arched crescents. The siphonal area is entirely smooth.

Essential differences exist in the shape of the sculpture of the inner and outer volutions. My materials have enabled me to sacrifice one of the larger specimens by scaling off its outer whorl in order to have the inner volutions accessible for observation. This inner nucleus is illustrated in fig. 3. It shows the characters of a typical species of the section of *Ceratites nodosi*.

The volutions do not overlap one another considerably, the lateral tubercles remaining outside the spiral of involution. The umbilical margin is adorned by a row of tubercles, from which straight, radial ribs originate. Most of the ribs bifurcate in very stout lateral tubercles, which are situated below the middle of the height of the flanks. The number of marginal tubercles is twice the number of umbilical ones. Occasionally intercalated ribs occur, which bear only marginal tubercles. This is the sculpture of *Ceratites trinodosus* or of *C. Thuilleri*, with the exception, however, that the ribs are more bulky and the lateral tubercles very stout and prominent.

The ribs are arranged symmetrically to a median plane. Where the intervals between the broad, not roof-shaped ribs meet from both sides of the shell, the siphonal area is very narrow and provided with a low but distinctly marked keel, as in *C. himalayanus* Blanf.

This ornamentation of normal species of the group of *C. binodosus* is restricted to volutions not exceeding a diameter of 40 mm. In the large specimen, illustrated in fig. 2, it is clearly exhibited in the posterior portion of the penultimate whorl. The anterior portion of this whorl exhibits neither the dichotomous arrangement of ribs nor three rows of tubercles. The umbilical tubercles soon become obsolete. The lateral tubercles, which are still very strongly developed, are situated outside the spiral of involution in a row, coinciding with the lower third of the sides. In the last volution this row has been shifted considerably nearer the spiral of marginal tubercles and is situated even a little above the middle of the lateral parts.

The difference in sculpture between young and adult individuals of this species is so remarkable that nobody would venture on their identification without the knowledge of complete examples permitting a study of all their stages of growth. It is by reason of this study that the systematic position of *C. truncus* can be established now with certainty.

According to the opinion of E. v. Mojsisovics (Arktische Triasfaunen, Mém. Acad. Impér. des sciences de St. Pétersbourg, XI ser., T. XXXII, No. 6, p. 21), *Ceratites truncus* belongs to the section of *C. subrobusti* (*Keyserlingites* Hyatt). The character of the inner volutions proves the incorrectness of this suggestion, based on too scanty materials. In young stages of growth *C. truncus* is a typical representative of the section of *C. nodosi*, with three rows of spines, and with dichotomous ribs, bifurcating in lateral tubercles. It is only in later stages of growth that the umbilical spines disappear and that all the ribs become simple. The lateral tubercles in the outer volutions of *C. truncus* do not correspond to umbilical spines in the inner volutions, as in *Keyserlingites*, but retain their lateral position throughout all stages of development of the shell.

But apart from this difference in sculpture, the inner volutions of *C. truncus* are entirely different from young individuals of *Keyserlingites* in their general shape and outlines. They are flat and high-mouthed, not globose and inflated. *C. truncus* must consequently be removed from the section of *C. subrobusti* and placed among that of *C. nodosi*.

Sutures.—I have nothing to add to the description in Vol. II, Pt. 2, of this series.

Locality: number of specimens examined.—North-north-west of Kágá (Spiti), 2; Muth, 3; Kuling, 1, all coll. Hayden.

8. Ceratites Devasena nov. sp. Pl. IV, fig. 4.

1895. *Ceratites Vyasa* Diener *ex parte*, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2. The Cephalopoda of the Muschelkalk, p. 19, Pl. VI, fig. 1 (*non* fig. 2).

1899. *Ceratites nov. sp.* A. v. Krafft, General Report, Geol. Surv. of India for 1898-99, p. 20.*

Two different species were included by me in 1895 under the name of *Ceratites Vyasa*, as has been stated by A. v. Krafft. My examination of the rich materials of both species collected by Hayden has convinced me that A. v. Krafft's suggestion was fully justified and that the two species also even belong to two different groups of *Ceratites*, which, however, agree entirely in the shape of their outer volutions. As my description of the inner whorls of *C. Vyasa* has been chiefly based on observations of the specimen represented in fig. 2, Pl. VI, of my above-quoted memoir, I shall confine the name *C. Vyasa* to the latter, in accordance with A. v. Krafft, whereas a new name, *Ceratites Devasena*, must be introduced for the example represented in fig. 1.

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* On labels attached to the specimens included in the present species by A. v. Krafft, I find the name *Ceratites Dieneri nov. sp.* in A. v. Krafft's own handwriting. I am sorry that this denomination cannot be accepted because it has meanwhile been attributed to the Indian type of *Ceratites subrobustus* from the Shalshal cliff by E. v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl., K. K. Geol. Reichsanst, VI, Supplem. 1902, p. 328). The two groups of *Ceratites nodosi* and of *C. subrobusti* (*Keyserlingites*) are too nearly allied to permit the use of the same specific denomination in both of them.

A. v. Krafft describes the inner whorls of this new species as recalling *Ceratites nov. sp. ex. aff. C. subrobustus* Diener (l. c. p. 27, Pl. V, fig. 6), although flatter sides, a well-marked umbilical margin and the absence of a keel are considerable points of difference. I am bound to confess that I cannot find any similarity with a species of the group of *C. subrobusti*. The example illustrated in the present memoir has its inner volutions excellently preserved. I have chiselled them out of a full-grown specimen with a diameter of 180 mm. by scaling off the outer whorls, leaving only a small portion of the penultimate volution, in order to show the remarkable difference in ornamentation between the inner and outer whorls.

General shape, involution and pattern of sculpture in the inner nucleus are those of *C. Thuilleri* Oppel. The transverse section is more strongly compressed, the area narrower and more highly vaulted, the ornamentation flatter and less prominent than in *C. Thuilleri*, but in general this is certainly the species to which young individuals of *Cer. Devasena* appear to be most nearly allied. There are three rows of tubercles developed, adorning broad and bulky ribs, but the umbilical and lateral tubercles are often amalgamated into a single one, especially so in the innermost volutions.

The involution takes place outside the spiral row of lateral tubercles. In the lateral tubercles bifurcations of ribs occur frequently but not regularly. The number of marginal tubercles is certainly less than twice that of the double of lateral ones.

The outer volutions are exactly alike those of *Ceratites* (*Hollandites*) *Vyasa* Dien. A safe distinction of the two species becomes, indeed, impossible without the knowledge of their inner whorls.

There exists a close relationship between *C. Devasena* and *C. truncus* Oppel, both species being characterised by the tendency to develop in later stages of growth a sculpture consisting of single radial ribs, which are never dichotomous. *C. truncus* is, however, provided with a larger umbilicus, its inner whorls are less high, with a broader area, and stout umbilical tubercles play a more prominent part in their sculpture. In full-grown specimens of *C. Devasena* stout marginal elevations only are developed. Lateral tubercles or prominences, as distinctly marked as in *C. truncus*, have not been noticed in any of my specimens.

Dimensions—(of the inner nucleus).

Diameter of the shell	74 mm.
" " " umbilicus	23 "
Height of the last volution	31 "
Thickness " " "	19 "

Locality : number of specimens examined.—North-north-west of Kágá (Spiti), 3, coll. Hayden.

Sutures.—In the specimen illustrated a large auxiliary saddle has been noticed outside the broad umbilical lobe, which consists of several rudimentary lobes and saddles.

9. Ceratites Kuvera Diener (*var.* Pl. IV, fig. 5).

1895. *Ceratites Kuvera* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, 2. The cephalopoda of the Muschelkalk, p. 25, Pl. V, fig. 2.

One single specimen only from the Muschelkalk of Kalapani, Byans, was known to me in 1895. An examination of larger materials collected near Jolinka, Byans, by Smith, shows that the species is subject to considerable variability and that intermediate forms occur between *Ceratites Kuvera* and *C. Thuilleri* Oppel, its nearest ally.

The typical form of *Ceratites Kuvera* is distinguished by slowly-increasing whorls, enclosing a wide, open umbilicus, by a moderately-curved, not steep, umbilical wall, which passes gradually into the lateral parts, and by a very broad and flat siphonal area. In old age the ribs are single, straight and adorned with lateral and marginal spines only, the faintly-developed umbilical tubercles disappearing completely. The shape of the body-chamber volution recalls that of *C. truncus* or *C. Devasena.*

The specimen illustrated in fig. 5, Pl. IV, of this memoir, holds an intermediate position between *C. Kuvera* and *C. Thuilleri*, although I prefer to leave it in the present species. It recalls *C. Thuilleri* in so far as the umbilical wall is distinctly defined and very steep in the inner volutions; the area is roof-shaped, not flattened. It agrees, however, with *C. Kuvera* in the presence of a wide, open umbilicus and of a comparatively low aperture, in the absence of umbilical tubercles and in the character of ornamentation in the last half volution. The involution takes place rather far outside the spiral of lateral tubercles.

The difference between this specimen and *C. Thuilleri* will be clearly seen from a comparison of its measurements and the dimensions of Oppel's type-specimen of *C. Thuilleri.*

Dimensions.

	C. Kuvera.	*C. Kuvera.*	*C. Thuilleri.*
	Type-specimen.	Var. Pl. IV, fig. 5.	Type-specimen.
Diameter of the shell	85 mm.	67 mm.	77 mm.
,, ,, ,, umbilicus	28 ,,	23 ,,	23 ,,
Height of the last volution	33 ,,	26 ,,	33 ,,
Thickness ,, ,, ,, ...	21 ,,	18 ,,	24 ,,

The difference between the height of the last volution and the width of the umbilicus is much more considerable in *C. Thuilleri* than in *C. Kuvera* even in our variety, which in some of its characters strongly recalls *C. Thuilleri* and may be looked upon as an intermediate form between those two species.

Sutures.—The difference in the sutural line between *Ceratites Kuvera* and *C. Thuilleri* is insignificant. The enlargement of the lobes at their base and their contraction towards their upper portion, so well marked in the type-specimen of *C. Kuvera* from Kalapani, is but faintly developed in the examples collected by F. H. Smith. It is certainly not a character of specific importance.

Locality : number of specimens examined.—Jolinka, Byans, 4, coll. Smith.

10. Ceratites Padma nov. sp. Pl. V, fig. 4.

The only specimen from Kágá, Spiti (coll. Hayden), fragmentary as it is, deserves a special description, because it represents a very remarkable case of convergence. The fragment of the outer volution agrees in its shape, involution and ornamentation so closely with *Ceratites* (*Hollandites*) *Ravana* Dien., that I actually confounded it with this common species of the Himálayan Muschelkalk and discovered its difference accidentally when preparing its inner nucleus.

This inner nucleus is entirely different from the inner volutions of *Hollandites Ravana* (Pl. IV, fig. 7). It excludes at once any identification of the present species with *Hollandites*, but proves that it belongs to the section of *C. nodosi*. Its ornamentation recalls *C. truncus* Oppel. Bulky lateral ribs occasionally bifurcate from very high and strongly-developed lateral spines. They alternate with simple ribs devoid of spines. All the ribs originate in faintly-developed umbilical tubercles and terminate in low, marginal knobs.

A siphonal keel is but indistinctly developed. The lateral and umbilical tubercles are situated very closely to each other, as in *Ceratites brembanus* E. v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 38, Taf. X, fig. 1-4), to which the inner nucleus of our species seems to be nearly allied.

Sub-genus: *Philippites* nov. sub-gen.

1905. Philippites, Diener, ~~[illegible]~~ Systematik der Ceratitiden des Muschelkalkes, p. 8

type = As has been remarked in the introduction to this chapter, the Alpine group of *Ceratites Erasmi* Mojs., *C. Aster* Hauer and *C. tuberosus* Arth. must be separated from the Indian group of *C. circumplicati* (*Hollandites*). In accordance with Philippi I am inclined to consider them as forming an independent section of the genus *Ceratites*, for which I propose the sub-generic designation of *Philippites*.

In the Himálayan Trias this sub-genus is represented by *Ceratites nov. sp. ind.* Diener (Himál. Foss. Palæont. Ind., ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 8, Pl. I, fig. 3) and by a new species from the Muschelkalk of Byans.

Philippites Jolinkanus nov. sp. Pl. IV, fig. 6, Pl. V, fig. 2.

This species is represented in F. H. Smith's collections from Jolinka, Byans, by a single, well-preserved example, consisting of air-chambers with a small portion of the body-chamber adhering, and by numerous fragments. In fig. 2, Pl. V, the largest fragment of a body-chamber has been illustrated.

Philippites Jolinkanus is very nearly allied to the Alpine representatives of the sub-genus and strongly recalls in its sculpture *Dinarites spiniplicati*. It is of obliquely-elliptical outlines. The whorls overlap each other to a little less than one-half their height. The transverse section is cordiform, with rounded umbilical and siphonal margins. In old age a steep umbilical wall is developed. The greatest thickness of the volutions coincides with the umbilical margin.

The sculpture consists of strong, but indistinctly defined, umbilical tubercles, which pass gradually into radial ribs. Those ribs decrease in strength in the direction of the siphonal margin and become obsolete before reaching it. The regularly rounded siphonal part is entirely smooth. In the inner volutions either one single or two ribs originate from an umbilical tubercle. In the body-chamber, however, all the ribs are simple.

Philippites Jolinkanus differs from *Ph. Erasmi* v. Mojs., *Ph. aster* v. Hauer and *Ph. tuberosus* v. Arth. by its dichotomous ribs, but in the Arctic group of *Dinarites spiniplicati* two short spiniplicate ribs occasionally originate from one single umbilical tubercle and in *Keyserlingites Middendorffi* Keyserl. bifurcations of spiniplicate ribs in the umbilical spines are even a predominating element of sculpture.

Dimensions.

Diameter of the shell		61	mm.
„ „ „ umbilicus		19·5	„
Height of the last volution	above the umbilical suture	25	„
	„ „ preceding whorl	20	„
Thickness of the last volution		17	„
Height of the last whorl in the place of its greatest applanation		18·5	„
Thickness „ „ „ „ „ „ „		15·5	„
Corresponding diameter of the shell		43	„
„ „ „ umbilicus		11	„

Sutures.—Sutures on a considerably lower stage of development, than in *Ph. aster*, *Ph. tuberosus* or *Ph. Erasmi*. Lobes serrated, but with short basal indentations only, margins of saddles entire. Both the lobes and saddles are narrow and slender. Only the siphonal lobe is broad and divided by a narrow median prominence. One auxiliary lobe but no saddle outside the umbilical suture.

The character of the sutural line recalls *Keyserlingites Middendorffi* Keyserl. (E. v. Mojsisovics, Arktische Triasfaunen, Mém. Acad. Impér. des sciences, St. Pétersbourg, VII sér., T. XXXIII, No. 6, Pl. III, fig. 1c).

Sub-genus: *Halilucites* nov. sub-gen.

(Group of *Ceratites rusticus* v. Hauer.)

HALILUCITES sp. ind. ex. aff. PLANILATERATO v. Hauer. Pl. V, fig. 3.

A single species from the Muschelkalk of the Shalshal cliff (coll. Krafft) is, unfortunately, not sufficiently well preserved to admit of specific determination, although it certainly belongs to the sub-genus *Halilucites*. It is very nearly allied to *Halilucites planilateratus* v. Hauer (Beitræge zur Kenntniss der Cephalopoden aus der Trias von Bosnien, II. Denkschr. Kais. Akad. d. Wiss., LXIII, p. 261, Taf. XI, fig. 1-3), but whether or not the European and Indian forms are specifically identical, cannot be decided.

The shell is discoiform, comparatively flat and widely umbilicated. The volutions overlap one another to about one-half their height. The flat area is elevated into a very high median keel, which is accompanied by shallow furrows on either side. It is separated from the lateral parts by a bluntly rounded margin. The lateral parts are flattened and nearly equidistant throughout their entire height. The transverse section is therefore almost rectangular in outline. Umbilical margin sharply-rounded, but not acute. Umbilical wall low, but steep.

The sculpture of the lateral parts consists of bulky and straight, or slightly falciform, ribs of unequal strength. Most of the ribs are simple, but bifurcations occur rather frequently, either at the umbilical margin, or, more rarely, in the middle of the height of the flanks. Some ribs are distinguished from the rest by their greater strength and irregular distance. Umbilical tubercles faintly marked.

Near the siphonal margin nearly all the ribs become more prominent and are elevated into marginal bumps, terminating in a sharp, forward-turned geniculation before reaching the siphonal furrows.

Dimensions.

Diameter of the shell		cca. 65	mm.
„ „ „ umbilicus		„ 20	„
Height of the last volution	above the umbilical suture	„ 27	„
	„ „ preceding whorl	„ 22	„
Thickness of the last volution		„ 17	„

Sutures.—The sutures, so far as preserved, seem to agree with those of *Halilucites planilateratus*. Lobes ceratitic, saddles entire. The siphonal and second lateral saddles are of equal height and lower than the principal lateral saddle. Siphonal lobe not known to me. Principal lateral lobe considerably deeper than the second. An auxiliary saddle is divided by the umbilical margin.

Sub-genus: *HOLLANDITES* nov. sub-gen.

1905. Hollandites, Diener, Entwurf einer Systematik der Ceratitiden des Muschelkalkes p. 776

(Group of *Ceratites circumplicati*).

type =

1. HOLLANDITES VOITI Oppel. Pl. VII, figs. 3, 4.

1860. *Ammonites Voiti* Oppel, Palæontologische Mittheilungen aus dem Museum des kgl. bayrischen Staates I. p. 276, Taf. 77, fig. 1.

1895. *Ceratites Voiti* Diener, Himál. Foss. Palæont. Ind., ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 8, Pl. II, figs. 1, 2.

In my description of this species in 1895 I was obliged to leave its diagnosis incomplete, because in none of my specimens were the inner volutions satisfactorily preserved. Hayden's new materials from the Muschelkalk of Spiti are so rich in examples that I could afford to sacrifice two full-grown specimens, the outer volutions of which I have scaled off gradually in order to make the inner nuclei accessible for examination.

The two nuclei, illustrated in this memoir, show a remarkable similarity to the inner volutions of ***Ceratites Petersi*** Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 27, Taf. XI, fig. 10). E. v. Mojsisovics was, indeed, perfectly right in remarking the affinity of those two species.

As in *Ceratites Petersi*, the transverse section is lenticular with a broadly-rounded area, which gradually passes into the flanks without any distinct demarcation. The sculpture consists of numerous straight or slightly falciform ribs of unequal strength and distance. The inner nuclei of *H. Voiti* differ from *Ceratites Petersi* by their wider umbilici and by the absence of lateral tubercles, which in the Alpine species are acquired at earlier stages of growth. In the specimen illustrated in fig. 3, Pl. VII, at a diameter of 34 mm. no tubercle has as yet been developed, whereas in the young example of *Ceratites Petersi* illustrated by E. v. Mojsisovics, the first lateral tubercle makes its appearance at a diameter of 17 mm.

A comparison of the inner nuclei of *Hollandites Voiti* and *Ceratites Thuilleri* shows at once the great difference in the development of their sculpture. There is another group of ammonites with ceratitic sutures, to which the external similarity of the two illustrated nuclei is much more clearly marked than to the section of *C. nodosi*. This is the group of forms, which in my above-quoted memoir were described as *Meekoceras Nalikanta* (l. c. p. 45, Pl. IX, fig. 5) and *Meekoceras Srikanta* (l. c. p. 46, Pl. VIII, figs. 8, 9) and which in my memoir on the Cephalopoda of the lower Trias of the Himálayas (ibid. Vol. II, Pt. 1, p. 73) were placed in the genus *Proptychites* Waagen.

In this latter memoir I stated that those species from the Muschelkalk of the Shalshal cliff, included provisionally in the genus *Proptychites*, differed from the lower Triassic species of *Proptychites* from the Salt Range by a more strongly falciform sculpture. Now I think, that they should, indeed, be united with *Hollandites* rather than with *Proptychites*. An examination of the innermost volutions of *H. Voiti* has convinced me, that in quite young stages of development their shells are thickly globose, exactly as in *Proptychites* (?) *Srikanta*, *P. Nalikanta* and *P. Narada*.

That none of those three species is identical with young examples of *H. Voiti* may be seen from differences in their ornamentation and in their sutural lines. In *H. Voiti* the sculpture is more strongly marked and irregular and the saddles are brachyphyllic at very early stages of growth.

An Alpine species, which also strongly recalls *H. Voiti* in the shape of its inner nuclei, is *Beyrichites Beneckei* v. Mojsisovics (Cephalopoden der Mediterr. Triasprovinz, l. c., p. 216, Taf. XXVIII, fig. 1, XXXIX, fig. 6, LIX, fig. 2-4). If we compare the illustration fig. 4 on Pl. LXI of E. v. Mojsisovics' monograph with our figure, we find a remarkable similarity in the development of straight and strong radiating ribs, reaching across the flanks from the umbilical to the siphonal margins.

Among the Ceratites of the Arctic region it is chiefly ***Ceratites decipiens*** v. Mojsisovics (Arktische Triasfaunen, Mém. Acad. Impér. des sciences de St. Pétersbourg, VII ser., T. XXXIII, No. 6, p. 27, Tab. VI, fig. 9), which may claim comparison. The similarity is, however, restricted to the pattern of ornamentation. Otherwise inner nuclei of *C. decipiens* differ from those of *H. Voiti* by their very globose whorls and by the arrangement of their sutural line.

Ceratites decipiens is certainly the prototype of a group to which a sub-generic value must be attributed.

Locality: number of specimens examined.—This species is richly represented in the Himálayan collection, especially from the Muschelkalk of Spiti. Kágá 6, Kuling 1, Muth 4, all coll. Hayden.

2. HOLLANDITES RAVANA Diener. Pl. IV, fig. 7.

1895. *Ceratites Ravana* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pl. 2. The Cephalopoda of the Muschelkalk, p. 10, Pl. II, fig. 5, var. Pl. II, fig. 3.
1895. *Ceratites nov. sp. ind. aff. C. Ravana* Diener, ibid. p. 11, Pl. II, fig. 4.
1895. *Ceratites sp. ind. ex. aff. C. Ravana* Diener, ibid. p. 12, Pl. II, fig. 6.

The examination of rich materials of this species has convinced me of the wide range of the variability in its sculpture. I therefore prefer to include the fragments which were formerly considered as *C. sp. ind. ex. aff. C. Ravana* in the present species.

The full-grown example from the Shalshal cliff, illustrated in fig. 5, Pl. II, may be regarded as the type. With this form most of the specimens in the Himálayan collection agree. The large number of distinctly falciform ribs, originating in pairs at the umbilical margin, and the insignificant rôle that tubercles play in the ornamentation, make a distinction from the nearly-allied *H. Voiti* an easy matter. The distinction becomes, however, more difficult in those varieties in which bifurcations of ribs are noticed in the lower portions of the lateral parts and are combined with a slight swelling of the ribs (Pl. II, fig. 4) or even with true lateral tubercles (Pl. II, fig. 6).

All those types are connected with each other by intermediate shapes and may be considered as transitional forms between *H. Ravana* and *H. Voiti* Oppel.

In full-grown individuals of the typical form the sculpture is also subject to some variation. A specimen measuring 83 mm. in diameter, from the ridge between the Dharma and Lissar valleys (coll. La Touche), is lying before me, in which the ribs are considerably broader in the vicinity of the aperture than in my type-specimen from the Shalshal cliff, and are covered with numerous, distinctly marked striæ of growth. The same character has been noticed in an adult example from Kágá, with a diameter of 105 mm. In both specimens umbilical tubercles are entirely absent in the body-chamber.

Young individuals of *Hollandites Ravana* differ considerably from equal sized specimens of *H. Voiti* by their coarse sculpture, which consists of closely-set, equidistant and distinctly falciform ribs. The fig. 7 on Pl. IV of this memoir represents the inner nucleus of a large example from Muth, belonging to the typical form of *H. Ravana*. The sculpture near the beginning of the last volution, corresponding to a diameter of 22 mm., is of special interest, because it affects equally the lateral and siphonal parts. The lateral ribs meet from both sides in the middle of the regularly rounded siphonal area. The same character has been noticed in the inner volutions of *H. Vyasa*.

Locality: number of specimens examined.—Muth (Spiti) 4, coll. Hayden; Kágá (Spiti) 6, coll. Hayden; ridge between Dharma and Lissar valleys, Kumaon, coll. La Touche.

3. HOLLANDITES AIRAVATA Diener. Pl. VII, fig. 5.

1895. *Ceratites Airavata* Diener, Himálayan Foss., Palæont. Indica, ser. XV, Vol. II, Pt. 2. The Cephalopoda of the Muschelkalk, p. 12, Pl. IV, fig. 3.

This species differs from *Hollandites Ravana*, to which it is very nearly allied, by subordinate details in its involution and sculpture. Its umbilicus is narrower and in its ornamentation umbilical tubercles are more prominent than the lateral ribs, at least in adult stages of growth. The development of distinct umbilical tubercles is, however, noticed in the inner nuclei already. A comparison of the illustrated young specimen of *H. Airavata* with the inner volutions of *H. Ravana* (Pl. IV, fig. 7) shows this difference between the two species very clearly.

In old age the lateral ornamentation grows more delicate, the umbilical tubercles only persisting throughout the entire length of the body-chamber. A large specimen from the ridge between the Dharma and Lissar valleys, Kumaon, with a diameter of 82 mm., shows very numerous and delicate, falciform striæ of growth only, elevated occasionally into low and narrow folds, but a small number of stout tubercles along the umbilical edge. The umbilicus of this full-grown specimen, the largest known to me, is 13 mm. in width, whereas in the type-specimen of *H. Ravana* of the same size the diameter of the umbilicus is 23 mm.

Locality: number of specimens examined.—North-north-west of Muth, Spiti, 1, coll. Hayden; south-east of Po, Spiti, 1, coll. Hayden; ridge between Dharma and Lissar valleys, Kumaon, 1, coll. La Touche.

4. HOLLANDITES VISVAKARMA Diener.

1895. *Ceratites Visvakarma* Diener, Himálayan Foss. Palæont. Ind., ser. XV, Vol. I, Pt. 2. The Cephalopoda of the Muschelkalk, p. 16, Pl. IV, fig. 2.

An excellently preserved example of this species has been collected in the Muschelkalk of Kágá, Spiti, by Hayden. It agrees exactly with my type-specimen from the Shalshal cliff in its dimensions, involution and sculpture.

Its last volution is high-mouthed and strongly compressed at its beginning, but becomes considerably thickened near its aperture, where the proportion of height to thickness is 42 to 32 mm. The aperture probably coincides with the peristome, the length of the body-chamber measuring exactly one-half volution.

The sculpture is very characteristic, consisting of simple radial ribs only, which are strongly developed only in the anterior portion of the last volution. Thus *Holl. Visvakarma* represents one of the simplest types of circumplicate ornamentation. As in my type-specimen from the Shalshal cliff the greatest height of the ribs coincides with the middle portion of the lateral parts. Only the last two ribs preceding the aperture show prominent elevations in the marginal region.

Sutures.—The sutures of *H. Visvakarma* differ from the type of sutures exhibited in *H. Voiti* Oppel and its allies by the presence of well-developed auxiliary saddles.

5. Hollandites Roxburghii nov. sp. Pl. IX, fig. 1.

I was not sure for some time, whether a small number of Ceratites from the Muschelkalk of Jolinka, Byans (coll. F. H. Smith), should be considered as a proper species or only as an elliptical variety of *H. Visvakarma*. I have decided in favour of the first alternative, because the species from Jolinka is subject to considerable variations in its inflation and involution. If I had united it with *H. Visvakarma*, I should have been obliged to introduce a range of circumscription in the latter species, which could not have been applied to the typical form from the Muschelkalk of Spiti. This view is supported by the presence of essential differences in the arrangement of the auxiliary series of the sutural line.

All my specimens are of strongly elliptical outlines, but it is impossible to decide whether this elliptical shape is accidental or characteristic of the species, the majority of the ammonites from this locality being distinguished by an obliquely elliptical shape. In their involution they are subject to great variability. The illustrated type-specimen agrees with *Holl. Visvakarma* in the presence of very slowly-increasing whorls overlapping each other to one-third part of their height only and leaving a wide umbilicus open. But there are other examples, more involute and provided with a narrower umbilicus. The whorls are strongly compressed and high, but become considerably inflated in the vicinity of the apertural margin.

The sculpture agrees exactly with that of *H. Visvakarma*. The inner volutions are covered with straight, radial, delicate ribs. It is only in the anterior portion of the last volution, that the ribs become stout and elevated, especially in the middle of the sides.

Dimensions.

Diameter of the shell	110 mm.
„ „ „ umbilicus	30 „
Greatest height of the last whorl	44 „
„ thickness „ „ „ „	33 „
Height of the last whorl at the place of its greatest applanation	30 „
Thickness „ „ „ „	19 „
Corresponding diameter of the shell	69 „
„ „ „ umbilicus	16 „

Sutures.—The sutures are but partly known to me. They differ in their arrangement from those of *H. Visvakarma* by the presence of a broad umbilical lobe, which is irregularly serrated but does not exhibit distinct auxiliary elements, whereas two auxiliary saddles are distinctly developed in *H. Visvakarma.*

Locality: number of specimens examined.—Jolinka, Byans, 5, coll. Smith.

Remarks.—Indifferently-preserved examples of this species exhibit a remarkable similarity with *Ptychites rugiferi* deformed by pressure. They can, however, be easily distinguished by the different character of their sutural lines.

6. HOLLANDITES DUNGARA, Diener.

1895. *Ceratites Dungara* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2. The Cephalopoda of the Muschelkalk, p. 15, Pl. II, fig. 2.

Of this species numerous and fairly well-preserved specimens have been found in A. v. Krafft's and Hayden's collections. In general, they are very similar to the widely-umbilicated variety of *H. Voiti*, but can always be distinguished by their sharpened ribs, which are strongly elevated in the middle portion of the lateral parts. These elevations do not assume the shape of true tubercles but are strongly elongated in a radial direction. Marginal tubercles are but exceptionally developed and only in the body-chamber of full-grown specimens.

The involution is subject to considerable variation. In some examples even a sort of egression of the umbilicus is noticed, the umbilical suture leaving the normal spiral of involution.

The whorls overlap one another to one-third of their height only or a little more, but always less than one-half their height, whereas in the typical form of *H. Voiti* the rate of involution is even more than one-half the height of the lateral parts.

Locality: number of specimens examined.—Shalshal cliff 1, coll. Krafft; Kágá (Spiti) 1, coll. Krafft, 2, coll. Hayden; Muth (Spiti) 1, coll. Hayden; ridge between Dharma and Lissar valleys, Kumaon, 1, coll. La Touche.

7. HOLLANDITES HIDIMBA Diener.

1895. *Ceratites Hidimba* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pl. 2. The Cephalopoda of the Muschelkalk, p. 13, Pl. III, fig. 1.

Of this species one single, imperfect specimen only from Muth, Spiti, has been found in the Himálayan collection. Its outer volution shows the peculiar sculpture illustrated in the type-specimen from the Tsang tsok la, Hundes.

8. HOLLANDITES MOOREI nov. sp. Pl. VIII, fig. 1.

At first glance the present species seems to resemble very closely *Hollandites Hidimba.* Both species agree exactly in their general shape, transverse section and involution, and even in the ornamentation of the outer whorl, although the radial ribs are less sharp and lower in *H. Moorei* and do not show the strongly forward-bent curve in the marginal region, which is noticed in *H. Hidimba.* But this feature is of very small importance compared with the difference of sculpture in the inner volutions.

H. Hidimba is a species in which the ornamentation is but faintly marked in young stages of growth, whereas the full strength of radial sculpture is attained in old age only. In *H. Moorei* just the opposite tendency of development is noticed. The outer volutions are less strongly sculptured than the inner ones, which are covered with radiating ribs of irregular strength, some of them bulky and very stout, surpassing in size considerably those in the last volution. This character makes the distinction of the two species an easy matter, if one has to do with complete specimens, but the determination of fragmentary outer whorls is rather unsafe.

My type-specimen is almost entirely chambered.

Dimensions.

Diameter of the shell		140 mm.
" " " umbilicus		49 "
Height of the last volution.	above the umbilical suture	52 "
	" " preceding whorl	43 "
Thickness of the last volution		32 "

Sutures.—*Hollandites Moorei* is another species of the section of Indian *Ceratites circumplicati,* in which the difference of principal and auxiliary elements of the sutural line is not as clearly marked as in *H. Voiti* Oppel and its allies.

The first auxiliary lobe is followed by a well-developed auxiliary saddle with serrated margins. Otherwise the sutural line is very similar to that of *H. Hidimba.* All the saddles are serrated up to their topmost extremities. The siphonal lobe is very short. The second lateral lobe exhibits a tripartite termination.

Locality: number of specimens examined.—Muth (Spiti) 1, coll. Hayden, and a small number of fragments of outer volutions from the same locality and from the Bambanag cliff, Kumaon (coll. A. v. Krafft).

9. HOLLANDITES VYASA Diener. Pl. VII, figs. 1, 2.

1895. *Ceratites Vyasa* Diener, Himálayan Foss. Palæont. Indica, Vol. II, Pt. 2. The Cephalopoda of the Muschelkalk, p. 19, Pl. VI, fig. 2 (*non* fig. 1).

As has been explained in the description of *Ceratites Devasena,* the name *Hollandites Vyasa* must be restricted to the second of the two species which have been united by myself in 1895 under this denomination. The inner volutions of this species have been made accessible for examination in the two specimens illustrated in the present memoir. A comparison with the illustration of *C. Devasena* clearly shows the remarkable difference of their inner nuclei and proves the correctness of attributing *C. Devasena* to the section of *Ceratites nodosi* and *C. Vyasa* to the sub-genus *Hollandites.*

In *H. Vyasa* the inner volutions increase more rapidly than in *C. Devasena* and are entirely devoid of tubercles. Their sculpture consists of numerous radiating, straight or slightly falciform ribs of very unequal strength.

Most of the ribs are simple, but occasionally two ribs bifurcate near the umbilical margin. The ribs are broad and with rounded tops, not acute. In the inner nucleus illustrated in fig. 2, the ornamentation is not interrupted along the siphonal area up to a diameter of the shell of 40 mm., but the ribs pass over the broadly-rounded ventral area in a nearly straight line and without diminishing in size. In this stage of development the ribs are narrow and separated by regular intervals. In later stages of growth they become flattened, broader, and no longer cross the siphonal area, which gradually becomes compressed and sharply-rounded.

The sculpture of the outer volution agrees exactly with that in *C. Devasena.*

Dimensions.

	A full-grown specimen (fig. 2).	Inner nuclei.	
		Fig. 1.	Fig. 2.
Diameter of the shell	167 mm.	88 mm.	61 mm.
" " " umbilicus	64 "	22 "	9 "
Height of the last volution . . .	56 "	40 "	33 "
Thickness " " " . . .	45 "	24 "	15 "

Sutures.—Nearly identical with those of *C. Devasena* or *H. Voiti.* Saddles with strongly-serrated margins. No distinct auxiliary elements in the broad umbilical lobe.

Locality : number of specimens examined.—Kágá (Spiti) 3, coll. Hayden ; Muth 2, coll. Hayden, 1, coll. Krafft ; Bambanag cliff, near Martoli encamping ground, 1, coll. Krafft; Jolinka, Byans, 1, coll. Smith; lower Muschelkalk, Gyundi R., 1, coll. Krafft.

Remarks.—The absolute coincidence in the shape of outer volutions with *Ceratites Devasena* makes a determination of fragments, in which no part of the inner nucleus has been preserved, practically impossible. I am consequently unable to decide whether the interpretation of the fragment described as *Ceratites sp. ind. ex aff. Vyasa* in my memoir on the Cephalopoda of the Himálayan Muschelkalk (Pl. IV, fig. 6) was correct. Similar fragments have been noticed in A. v. Krafft's and Hayden's Himálayan collections in considerable number. They differ from the typical form of *H. Vyasa* by the broader intervals between the single ribs and by the strong development of marginal prominences.

Such specimens do recall *Ceratites evolutus* Philippi (Die Ceratiten des oberen deutschen Muschelkalkes, l. c. Taf. XLII, fig. 1) and even the typical *C. nodosus* (ibid. Taf. XLVII, fig. 1, 3) from the German Muschelkalk, but it only needs a glance at their sutures to see that they belong to very different groups and that their external resemblance is only a remarkable case of convergence.

11. Hollandites Cecilii nov. sp. Pl. III, fig. 6, Pl. VII, fig. 6.

The present species is very nearly allied to *Ceratites (Hollandites) nov. sp. ind.* Diener (Himálayan Foss., Palæont. Ind., ser. XV, Vol. II, pt. 2: the Cephalopoda of the Muschelkalk, p. 13, Pl. IV, fig. 4) from the Shalshal cliff. It agrees with this form and with *H. Moorei* in the tendency of its ornamentation to die out in later stages of growth. The sculpture is most strongly developed in the inner volutions and gradually disappears towards the aperture—so much so that the anterior portion of the last whorl in my larger specimen is almost entirely smooth. Even this specimen is provided with a very short part only of its body-chamber. The smaller example is an inner nucleus, consisting of air-chambers only.

The inner volutions show an elliptical transverse section, are moderately inflated and increase rather slowly, leaving a comparatively wide umbilicus open. The outer whorl is much more strongly compressed and provided with a highly-curved siphonal part. In this character my species agrees pretty well with the unnamed Himálayan form quoted above and also with *Hollandites Nalikanta* Dien., which I have previously placed among either *Meekoceras* or *Proptychites*.

The sculpture of the inner volutions is also very similar to that of *H. Nalikanta* Diener (Himálayan Foss., Vol. II, pt. 2, l. c. p. 45, Pl. IX, figs. 5, 7), but more strongly marked. It consists of a combination of simple and dichotomous, falciform folds, which are broad, bulky and elevated occasionally into irregularly-disposed prominences. The ornamentation of three examples, which I include in this species, does not agree in all its minor details, although the general pattern is the same.

There is specific identity neither with *Ceratites nov. sp. ind.* from the Muschelkalk of the Shalshal cliff nor with *Hollandites Nalikanta*.

From the first species our form differs by the shape of its ribs, which are neither straight nor turned obliquely forwards. In *H. Nalikanta*, the umbilicus is considerably narrower, the cross-section more lanceolate and the sculpture less strongly-marked, especially in the marginal region of the inner whorls.

Dimensions.

Diameter of the shell	60 mm.
" " " umbilicus	13 "
Height of the last volution { above the umbilical suture	32 "
" " { " " preceding whorl	23 "
Thickness of the last volution	17·5 "

Sutures.—Similar to those of *H. Nalikanta*, with the exception of the auxiliary series.

Siphonal and principal lateral lobes provided with deep indentations, which affect the marginal walls of the saddles up to the lower half of their height. Second lateral lobe short and faintly serrated. Saddles entire, principal lateral saddle higher than the second lateral and siphonal saddles, which are of equal height. The second lateral saddle is followed by a distinctly-defined auxiliary lobe. From this lobe to the umbilical suture three large indentations are counted, gradually decreasing in size and corresponding to rudimentary auxiliary saddles. The first auxiliary saddle, which is so distinctly marked in *H. Nalikanta*, is absent in *H. Cecilii*.

Locality ; number of specimens examined.—Bambanag cliff, Kumaon, 1, coll. Krafft; Kágá (Spiti) 2. coll. Hayden.

Sub-genus: *PERIPLEUROCYCLUS* nov. sub-gen.

The sub-genus *Peripleurocyclus* is distinguished by the persistence of siphonal ribs in all stages of growth. A single species only, *P. Smithianus*, from the Muschelkalk of the Himálayas, is known to me.

PERIPLEUROCYCLUS SMITHIANUS, nov. sp. Pl. IX, figs. 2, 3.

The fragment illustrated in fig. 3, containing a large portion of the body-chamber, ought to be considered as prototype of this species. It has strongly-compressed whorls, overlapping each other a little less than one-half their height, and with a cordiform transverse section. The largest transverse diameter corresponds to the umbilical margin. From this point the lateral parts converge very gradually towards the siphonal area, forming flat planes, which pass into the narrowly-rounded siphonal part in a moderately bent curve. The umbilical margin is more distinctly defined, forming an obtusely-rounded edge, which is separated from the umbilical suture by a perpendicular wall. The umbilicus is very large and appears rather shallow.

The sculpture is very characteristic. It consists of simple, radiating ribs, which are straight in the inner volutions, but are turned forward in the marginal region of the outer whorl. Tubercles are entirely absent. The ribs are less strongly developed in the umbilical than in the siphonal region of the shell and reach their greatest elevation in crossing the siphonal area. They are rounded above, not acute, and slope regularly towards the intercostal valleys.

In a second fragment, consisting of a portion of the body-chamber only, the ribs are but very faintly developed in the umbilical region of the shell, but very strongly marked along the crest of the siphonal area. This fragment recalls *Celtites (?) intermedius* v. Hauer (Beitræge zur Kenntniss der Cephalopoden aus der Trias von Bosnien, Denkschr. Kais. Akad. der Wissensch., LIX, 1891, p. 275, Taf. VII, fig. 3) from the Muschelkalk of Han Bulog, in its ornamentation but not in its involution.

The chambered specimen, figured on Pl. IX, fig. 2, is distinguished from the typical form by a more equal height of its ribs throughout their entire length. Their greatest development is attained in the middle and upper portions of the flanks, not in the siphonal region. The inner volutions are less densely ribbed than in the type-specimen, illustrated in fig. 3. Nevertheless, I do not think that these variations in sculpture would justify a specific separation.

Dimensions.—These cannot be measured, on account of the fragmentary state in which the specimens occur.

Sutures.—Only imperfectly known in the specimen illustrated in fig. 2, in which they have suffered considerably by weathering. Lobes with deep indentations, saddles slender and with entire margins.

Siphonal lobe short and provided with a high median prominence. Inner walls of the second lateral saddle coinciding with the umbilical margin. Only one auxiliary lobe outside the umbilical suture.

Locality: number of specimens examined.—Jolinka (Byans) 4, coll. Smith.

Sub-genus: *FLORIANITES* Hyatt.

FLORIANITES cf. KANSA Diener. Pl. V, fig. 5.

1895. *Danubites Kansa* Diener. Himál. Foss. Palæont. Indica, ser. XV, Vol. II. Pt. 2. The Cephalopoda of the Muschelkalk, p. 103, Pl. XXIX, fig. 1.

The illustrated specimen from the lower Muschelkalk of Gyundi R., Spiti (coll. Krafft), badly preserved as it is, shows a remarkable similarity to ***Florianites Kansa*** Diener from the lower Muschelkalk of the Triassic limestone crag of Chitichun No. 1. It agrees with my type-specimen from Chitichun in its general shape, distinguished by slowly-increasing, tube-shaped whorls, which scarcely overlap each other and are bordered by convex sides, with neither marginal nor umbilical edges,

The pattern of sculpture is also the same in both specimens. It consists of simple, radial ribs, confined to the lateral parts and dying out both in the umbilical and marginal regions. Nineteen ribs are counted to one-half volution. The number of ribs which occur in the last entirely-chambered volution of my type-specimen from Chitichun is 39.

In the present specimen a small portion of the body-chamber has been preserved. It differs from the chambered volutions by its more distant and strongly-inflated ribs, which slope obliquely towards the wide intercostal depressions. All the ribs are broadly-rounded along their tops.

Dimensions (of the inner volutions).

Diameter of the shell	58	mm.
" " " umbilicus	25	"
Height of the last volution	18·5	"
Thickness " " "	16	"

Sutures.—Not known in detail. Two lateral lobes and saddles.

Remarks.—It is only the imperfect state of preservation which induced me to abstain from a direct identification of the present specimen with *Florianites Kansa*.

There are two examples, still more fragmentarily preserved, referable to this species, both from the lower Muschelkalk of Lilang, Spiti (coll. Krafft).

Sub-genus: *SALTERITES* nov. sub-gen.

Ceratites Oberhummeri is the prototype of this new sub-genus, whose leading features are obvious from the following description:—

SALTERITES OBERHUMMERI nov. sp. Pl. V, fig. 1.

This species, represented by one single specimen from Muth, Spiti (coll. Hayden), is of special interest, combining, as it does, some characters of the groups of *Ceratites* *circumplicati*, and *C. nodosi*, and recalling strongly in its shape and sculpture some types of the group of *C. subrobusti* (sub-gen. *Keyserlingites*).

Salterites

The slowly-increasing whorls enclose a comparatively wide umbilicus. They are of nearly equal height and thickness in the adolescent stage of growth, but become strongly compressed in the outer volutions. The transverse section is of elliptical or rather lanceolate shape, the moderately curved lateral parts converging from the umbilical margin towards the siphonal area. The siphonal area is regularly arched, not roof-shaped or flattened in any stage of growth, and passes gradually into the flanks, without any distinct marginal demarcation. In the inner whorls a sort of bluntly rounded-off umbilical edge is developed, but in the last volution the umbilical margin is less distinctly defined and the umbilical wall slopes in a steeply-inclined plane towards the umbilical suture.

In the inner volutions the sculpture consists of stout and straight radial ribs. Some of these ribs are adorned with radially-elongated lateral tubercles. The involution takes place outside this spiral row of tubercles or bumps, which are consequently exhibited within the umbilicus.

At the beginning of the last volution the tubercles become very large, but take their position in the vicinity of the umbilical margin. As a rule, a bifurcation of ribs corresponds to these tubercles. The ribs are no longer straight, but slightly falciform, being turned forward in the vicinity of the siphonal margin, where they terminate in distinct, but small tubercles. If we except the abnormal development of umbilical bumps, this type of ornamentation is similar to that noticed in numerous species of the Indian group of *Ceratites circumplicati* (*Hollandites*).

In the anterior portion of the last volution the radially-elongated tubercles are gradually shifted from their umbilical into a lateral position, but continue to serve eventually as points of bifurcation of the ribs, which are broad and vaulted. This pattern of sculpture recalls the group of *Ceratites nodosi*.

Notwithstanding this apparent affinity to Indian species of *Ceratites circumplicati* and *C. nodosi* there is a still more remarkable similarity with some types of *Keyserlingites*, especially with *Keys. Schrenki* v. Mojsisovics (Arktische Triasfaunen, Mém. Acad. Impér. des sciences de St. Pétersbourg, VII sér., T. XXXIII, No. 6, p. 42, Pl. IV, fig. 1) and *Keys. Vega* Oeberg (Om Trias foersteningar från Spetsbergen, Konigl. Svenska Vetensk. Akad. Handl. XIV, No. 14, p. 14, Taf. IV, fig. 2.)

In outlines, involution and in the shape of the transverse section there is a remarkable resemblance with *Keyserlingites Schrenki*, especially the lanceolate shape of the aperture, the rounded siphonal area, and the absence of any umbilical or marginal edge are very similar in both species, although those features are equally well noticed in several species of the group of *C. circumplicati*. But the character which chiefly recalls *Keys. Schrenki*, is the preponderance of abnormally developed umbilical tubercles. In *K. Schrenki* ribs play a rather insignificant part, but in *K. Vega* ribs of the same pattern as in *Salterites Oberhummeri* are distinctly developed, although in a smaller number.

The gradual passage from umbilical into lateral tubercles in successive stages of growth has been described in another species of *Keyserlingites*, *K. Bungei*, by E. v. Mojsisovics (Mém. Acad. Impér. des sciences de St. Pétersbourg, VII sér., T. XXXVI, No. 5, p. 8, Pl. I, fig. 14). It is, indeed, very probable that the present species ought to be placed among the *C. subrobusti* rather than among the *C. circumplicati*. It certainly shows the intimate relationship between all those groups which cannot be separated as sharply as had been suggested by Philippi.

The only specimen of *Salterites Oberhummeri* available for examination consists of air-chambers only. This is the principal reason inducing me to consider it provisionally as an isolated form, because its systematic position cannot be ascertained definitely without the knowledge of its body-chamber.

From *Haydenites*, our species is easily distinguished by its general shape and by the presence of tubercles in the inner volutions.

Dimensions.

Diameter of the shell		87	mm.
„ „ „ umbilicus		26	„
Height of the last volution	above the umbilical suture	37	„
	„ „ preceding whorl	32	„
Thickness of the last volution		28	„

Sutures.—Not unlike those of *Keyserl. Schrenki.*

In the vicinity of the aperture the second lateral lobe coincides with the umbilical bumps. Principal lateral lobe with deep indentations, three of them occupying the base of the lobe, and an equal number affecting the marginal walls on each side. Indentations of the second lateral lobe restricted to the base.

Saddles entire, not serrated. The second lateral saddle is followed by a long umbilical lobe with numerous denticulations, as in the group of *Hollandites Voiti.* There is no proper auxiliary saddle developed.

Sub-genus: *HAYDENITES* nov. sub-gen.

This new sub-genus is proposed for the accommodation of the following species which occupies an isolated position among *Ceratites* on account of its peculiar shape and sculpture.

Its leading features are obvious from the specific description. I can, therefore, abstain from giving a complete diagnosis. In this sub-genus are included widely umbilicated Ceratites with outlines strongly recalling the Cretaceous genus *Acanthoceras* and with the ornamentation of *Hollandites* in the inner whorls, of *Keyserlingites* in the chambered portion of the last volution, and of *Ceratites truncus* Oppel in the body-chamber.

HAYDENITES HATSCHEKII nov. sp. Pl. VI, fig. 1.

This is one of the most remarkable species of *Ceratites*, on account of the great variation which its ornamentation undergoes in different stages of growth.

In young and adolescent stages it is a typical representative of the group of *Ceratites circumplicati*. In a more advanced stage of development it exhibits the sculpture of *C. subrobusti*, and in old age its ornamentation agrees with that noticed in the body-chambers of full-grown individuals of *Ceratites truncus* or *C. Devasena* among the *nodosi* or of *Hollandites Vyasa* among the *circumplicati*.

Thus it unites features which otherwise are found in different groups of Ceratites. Its systematic position must consequently remain uncertain. My personal opinion is that it should be considered as prototype of a special new group of *Ceratites*.

In the Himálayan collection this species is represented by a beautifully preserved example of very large size, from Kágá, Spiti (coll. Hayden), and by a fragment of a second specimen from the same locality, corresponding to such part of the complete example as is distinguished by the sculpture of *Keyserlingites*.

The complete specimen is one of the largest types of *Ceratites* hitherto known. Exactly one-half of the last volution belongs to the body-chamber, the aperture of which has been broken off along a plane of cleavage and does not show any traces of the vicinity of the peristome.

The whorls increase slowly and overlap one another to about one-half their height only, thus leaving a wide umbilicus open. The transverse section is approximately square and of equal height and width, with a regularly-rounded siphonal area. There are no other ammonites to which this species is so similar in its general shape and involution as to some Indian types of the Cretaceous genus *Acanthoceras* such as *A. Newboldi* Kossmat.

Both the siphonal and umbilical margins are distinctly marked, though not acute. The umbilicus is surrounded by a high and perpendicular wall.

The ornamentation of the inner volutions is very simple. It consists of very numerous radial ribs only, which are rounded on their tops and separated by intercostal valleys of equal width. Neither umbilical nor lateral tubercles are developed.

At the beginning of the last volution a very remarkable change in the sculpture is noticed. Lateral spines or tubercles of very large size make their appearance in the lower third of the flanks and serve as points of bifurcation of the radiating ribs. The spines are radially elongated. At the same time the ribs are elevated into small marginal tubercles, from which they continue, although in considerably reduced strength, across the siphonal area. This is exactly the pattern of sculpture as described and illustrated in *Keyserlingites Bungei* by E. v. Mojsisovics (Ueber einige Arktische Triasammoniten des noerdlichen Siberien, Mém. Acad. Impér. des sciences de St. Pétersbourg, VII sér., T. XXXVI, No. 5, p. 8, Taf. I, fig. 14). This sculpture continues as far as the beginning of the body-chamber.

Anteriorly to the last air-chamber the bifurcation of ribs in the lateral spines ceases, the ribs become simple, the lateral spines gradually die out or become mere swellings of the ribs, the marginal tubercles considerably increase in size and the ribs no longer cross the siphonal area, which gradually becomes entirely smooth. Thus the same type of ornamentation is reached in the body-chamber of the present species that we find in several species of *Ceratites s. s.* and of *Hollandites* (*C. truncus*, *C. Devasena*, *H. Vyasa*).

Dimensions.

Diameter of the shell		192 mm.
" " " umbilicus		54 "
Height of the last volution	above the umbilical suture	86 "
	" " preceding whorl	79 "
Thickness of the last volution		86 "

Sutures.—The siphonal lobe is considerably shorter than the principal lateral lobe and is provided with a very high and slender median prominence. There are two deep indentations at the base of each wing, and three at the base of the principal lateral lobe. The basal points are elongated and strongly developed.

All the saddles are entire, the incisions being restricted to the lower portions of their marginal walls. They are of nearly equal height, the level of the lobes gradually ascending towards the umbilical suture. Between the second lateral saddle and the umbilical suture there is an auxiliary lobe, consisting of two deep and pointed incisions and of two rudimentary saddles.

This development of the auxiliary series recalls *Hollandites* rather than *Keyserlingites.*

Sub-genus : *KEYSERLINGITES* Hyatt.

(Group of CERATITES SUBROBUSTI.)

1. KEYSERLINGITES DIENERI v. Mojsisovics. Pl. XI, figs. 1, 2.

1897. *Ceratites subrobustus* Diener, Himálayan Foss., Palæont. Indica, ser. XV, Vol. II, Pl. 1. The Cephalopoda of the lower Trias, p. 20, Pl. XVI, a, b, Pl. XIX, fig. 2.

1902. *Ceratites Dieneri* E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke, Abhandl. Geol. Reichsanst., VI-1, Supplementbd., p. 328.

In 1897 a large specimen of *Keyserlingites* from the Shalshal cliff was identified by myself with the characteristic Siberian species *Ceratites subrobustus* Mojs.

E. v. Mojsisovics, although having himself confirmed their identification in 1897, took a different view of the systematic position of the Indian species in 1902. He then considered it as a more specialised offspring of the geologically older *Ceratites subrobustus.* "In *Ceratites Dienere*" he says (l. c. p. 328) "the spines, which in *C. subrobustus* are situated near the umbilical margin, have been shifted towards the flanks and must therefore be designated as lateral spines. As in *C. Bungei*, ribs run from those spines downward to the umbilical suture in a straight direction. The sculpture of those two Ceratites consequently shows the pattern of ornamentation which is found in the type of *C. binodosus.*"

Had no other characters of distinction been found in the Indian type than those enumerated by E. v. Mojsisovics, I should not have accepted the specific separation of the Indian and Siberian forms as proposed by that learned author. The difference in the position of the spines is, I am afraid, purely imaginary. In the large Olenek specimen with body-chamber, illustrated by E. v. Mojsisovics in "Arktische Triasfaunen" (Mém. Acad. Impér. des sciences de St. Pétersbourg, sér. VII, T. XXXIII, No. 6) on Pl. V, the position of the spines is exactly the same as in my type-specimen from the Shalshal cliff. Short ribs run from those spines down to the umbilical suture. As no umbilical margin whatever is developed in the periphery of the tube-shaped whorls, it is simply a matter of convenience whether these spines be regarded as umbilical or lateral. I can only repeat—and my opinion has been confirmed by an examination of A. v. Krafft's recent material—that in the outer volutions of adult examples of Siberian and Indian *Ceratites subrobusti* no specific difference can be noticed. Although I hope to justify my view that ***Keyserlingites Dieneri*** is indeed a proper species, I am obliged to confess, that the features of distinction could not be observed in my type-specimens from the Shalshal cliff, but are of such a nature that they can only be observed in inner nuclei.

In my type-specimen the inner volutions were not accessible to examination. As I have stated in my description (l. c. p. 20) I have not been able to chisel them out of the extremely tough matrix. In A. v. Krafft's Himálayan collections from the lower Muschelkalk of the Shalshal cliff and of Lilang, two specimens were discovered agreeing exactly with the type-specimen in shape, involution and size, although both of them consist of air-chambers only, whereas in the former the body-chamber is almost entirely preserved. These two specimens have been partly sacrificed for chiselling out their inner volutions.

In the example from Lilang with an original diameter of 150 mm. three-quarters of the last volution have been scaled off. The remaining whorls have been illustrated in fig. 1 of Pl. XI. In the second specimen with a diameter of 183 mm. I have succeeded in taking out the penultimate whorl, without destroying the last volution. This latter has not been figured, because it agrees exactly with the chambered portions of the type-specimen illustrated in my above-quoted memoir and thus its illustration would not have added anything to our knowledge of the species. From the penultimate whorl the inner nucleus, consisting of the preceding volutions, has been chiselled out and illustrated together with a portion of the penultimate whorl in fig. 2 of Pl. XI. Thus the development of the shell through all stages of growth from a diameter of 22 mm.—corresponding to a height of the aperture of 7·5 mm.—has been made visible.

Now we shall follow the variations which the shell undergoes during these different stages of development.

In the specimen from Lilang the shape and sculpture of the penultimate whorl near the aperture do not differ remarkably from those in the chambered portion of the last volution. The whorls are still tube-shaped, with regularly rounded sides, although a flattening of the siphonal part is already noticed. The spines are situated at the point which corresponds exactly to the greatest transverse diameter of the cross-section. As in the last volution, the spines are encircled by the principal lateral saddle. The ribs bifurcate at the spines and cross the siphonal area without any interruption. The number of siphonal ribs originating from a single spine is often more than two. The continuity of sculpture in the siphonal area is also clearly marked in smaller specimens of the Siberian *Keyserlingites subrobustus* Mojs. (l. c. Taf. VI, fig. 1) and in *K. Middendorffi* Keys.

The change of shape and sculpture that *Keyserlingites Dieneri* undergoes in the penultimate volution is much more conspicuous in the specimen illustrated in fig. 2. In the penultimate whorl of this example from the Shalshal cliff the regular tubular form of the last volution gradually disappears. A broadly-vaulted siphonal area begins to separate itself from the flanks, which are still strongly convex and rise from the umbilical suture in an uninterrupted curve. The line of demarcation between the flanks and the siphonal area coincides with the greatest transverse diameter. Along this line are arranged the stout, spirally-elongated spines, from which bifurcating ribs originate, and pass across the siphonal area. Intercalated ribs also occur in the intervals between two spines. The flanks are nearly smooth, provided with indistinct, broad plications only, which rise from the spines and gradually die out before reaching the umbilical suture.

In the inner nucleus, corresponding to the whorl preceding the penultimate volution, the contrast between the flanks and the siphonal area is still more prominent. The siphonal area is nearly flat and separated from the moderately vaulted lateral parts by an obtuse edge. The cross-section is trapezoidal, with its greatest transverse diameter coinciding with the siphonal margin. In the sculpture the contrast between the smooth flanks and the richly ornamented siphonal area is strongly marked. The siphonal area is covered with numerous crescent-shaped ribs, crossing it with their convexity turned forward. The spines are very stout and situated exactly along the siphonal edge. If we make an exception for the richer ornamentation of the siphonal area, the inner nucleus of our species recalls very forcibly a species of the genus *Tirolites*, with its square transverse section and its marginal row of spines, especially *T. Haueri* Mojs. or *T. turgidus* Mojs. (Kittl, Cephalopoden der oberen Werfener Schichten von Muc. Abhandl. K. K. Geol. Reichsanst., XX, pp. 56, 59, Taf. IX, fig. 8-13, X, fig. 7, 8).

The inner nucleus of *Keyserlingites Dieneri* has not the external shape of *Dinarites spiniplicati* but of *Tirolites spinosi*. With reference to the siphonal area the position of the spines is neither umbilical nor lateral, but marginal.

Danubites nivalis Diener (Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 1, Cephalopoda of the lower Trias, p. 51, Pl. XV, figs. 17-19) from the Hedenstrœmia-beds of Muth, Spiti, with the peculiar tirolitic shape of its lateral sculpture in the body-chamber, shows also a remarkable similarity with our species, although the presence of strong ribs and the different transverse section make a distinction easy.

The similarity of the inner nuclei of *K. Dieneri* with *Sibirites Prahlada* Diener (Cephalopoda of the Muschelkalk, p. 37, Pl. VII, fig. 5) is still more remarkable, especially regarding the sculpture of the siphonal area. The resemblance is so great that I have, indeed, thought of the possibility that *Sibirites Prahlada* might be the inner nucleus of *K. Dieneri*. A closer examination has, however, led me to discard this suggestion entirely. The character and position of the spines are not the same in both species. In the nuclei of *K. Dieneri* the position of the spines is exactly marginal and the spines are elongated spirally. In *Sibirites Prahlada* the tubercles occupy a decidedly lateral position, are elongated radially, with half-moon-shaped tops, and are connected with short lateral ribs, which are entirely absent in *K. Dieneri*.

I have not been able to follow the developmental stages of this example to a smaller diameter of the nucleus than 14 mm. The polygonal spire inside the umbilicus, which is so characteristic in young individuals of Siberian representatives of *Keyserlingites*, is but faintly marked in the present specimen.

From our examination it is evident, that the inner nucleus of *K. Dieneri* differs entirely from *Dinarites spiniplicati* (*Olenekites*), the presumed ancestors of the sub-genus in Siberia, and that its apparent affinity is even much more close with *Tirolites*, which, according to E. v. Mojsisovics, belongs to an absolutely different developmental series of Triassic ammonites. This apparent affinity to *Tirolites* does not, however, stand a severe test, if we examine the development of the volutions of *K. Dieneri* in later stages of growth.

We have seen that in *K. Dieneri* the cross-section of the volution preceding the penultimate whorl is square-shaped and bordered by flanks and by a siphonal area, which are distinctly separated by an obtuse edge. Spines and greatest transverse diameter correspond to this siphonal margin or edge. Distinct ribs are confined to the siphonal area. In the anterior portion of the penultimate whorl the individualisation of lateral parts and siphonal area gradually disappears, the whorl becomes tube-shaped with a rounded cross-section, but the spines still correspond to the greatest transverse diameter. The difference in the shape of the cross-section is due to a gradual inflation of the siphonal area, which in the inner nucleus is nearly flat but turns strongly convex at the beginning of the last volution. In this siphonal area, which gradually increases in size so considerably that it occupies the larger half of the tube near the aperture of the penultimate whorl, an individualisation of two elements sets in in the last volution. An obtusely-rounded edge is developed along the spiral row of tubercles adorning the dichotomous ribs outside the primary row of large spines. In the last volution of full-grown specimens (Cephalopoda of the lower Trias, l. c. Pl. XVI) it is this edge which separates a flatly rounded siphonal area from moderately convex flanks on which the primary spines are disposed.

From this examination it is obvious *that the flanks in the last volution do not correspond to the flanks of the inner nucleus but are gradually developed from the siphonal part.* The flanks of the inner nucleus are homotaxial with the umbilical wall of the full-grown specimen, whereas both lateral parts and siphonal area of the last volution are homotaxial with the siphonal area of the inner nucleus.

It is consequently not correct to designate the primary spines of the inner volutions as marginal spines and to say that they have been shifted into a lateral or umbilical position in later stages of growth. *The position of primary spines has remained unaltered throughout all stages of development. The morphological elements of the tube have undergone a complete change.* The flanks of the inner nucleus have been reduced to the umbilical wall of the last volution, and the lateral parts and siphonal area of the adult shell have been developed from the broad and flat siphonal area of the inner whorls. Thus, the siphonal sculpture of the inner nucleus has been gradually turned into a lateral one.

Together with shape and sculpture the involution changes considerably in the inner whorls. In the last volution the whorls overlap one another to about one-half their height. With the flattening of the siphonal area the rate of involution decreases. In the inner volutions the whorls only touch each other. This change of involution is entirely due to the gradual transformation the siphonal area undergoes in passing from the inner nuclei into the adolescent stage of growth.

The spiral of involution remains unaltered throughout all stages of growth, corresponding exactly to the outer margin of the primary spines.

Thus, there is no question about the impossibility of constructing a developmental connection of *Keyserlingites Dieneri* with *Tirolites*. On the other hand, an intimate relationship to the *Dinarites spiniplicati*, the presumed ancestors of *K. subrobustus* Mojs., is excluded by the results of this examination. Inner nuclei of *K. Middendorffi* (E. v. Mojsisovics, Arktische Triasfaunen l. c. Pl. II, fig. 13) differ remarkably from those of *K. Dieneri*. The tube-shaped character of the volutions remains unaltered in a nucleus with a diameter of 11 mm. Of all the remarkable changes which the siphonal part of *K. Dieneri* undergoes in different stages of growth, nothing is noticed in *K. Middendorffi.*

This experience, I think, should be sufficient to decide whether the Indian types of the sub-genus are phylogenetically allied to the Siberian species, as has been suggested by E. v. Mojsisovics, or whether the astonishing resemblance in their external shape, sculpture and sutures is only a case of convergence. But in whichever way this question may be decided, nobody, I hope, will doubt the necessity of separating specifically the Indian and Siberian forms.

Dimensions.—The measurements of the specimen illustrated in fig. 2 are as follows:—

	Last whorl (entirely chambered).	Penultimate whorl.	Inner nucleus.
Diameter of the shell	153 mm.	60 mm.	22 mm.
" " " umbilicus	43 "	20 "	8 "
Height	76 "	24 "	7·5 "
Thickness	85 "	38 "	15 "

Sutures.—Agreeing with those of the type-specimen of *Keyserlingites Dieneri* and of *K. subrobustus*, but no auxiliary saddle outside the umbilical suture.

Locality: number of specimens examined.—Lower Muschelkalk, Shalshal cliff, 1, coll. Krafft; Lilang (Spiti) 1, coll. Krafft; Muth 1, coll. Hayden, and a small number of fragments from the same localities and from the Bambanag cliff, Kumaon, coll. Krafft.

It has been ascertained by A. v. Krafft (General Report, Geol. Surv. India, 1899-1900, p. 207, 1900-01, p. 26) that *Keyserlingites Dieneri* is a leading fossil of the lower Muschelkalk (horizon of *Spiriferina Stracheyi*) and does not belong to the lower Trias (Hedenstrœmia beds, horizon of *Flemingites Rohilla*), as had been suggested by myself in 1895. In the face of the convincing arguments brought forward by A. v. Krafft, I cannot deny the possibility that the only specimen known to me from the Shalshal cliff had not been collected *in situ*, as I formerly believed.

Remarks.—The fragmentarily preserved example from the Shalshal cliff, described as *Ceratites sp. ind. ex aff. Middendorffi* in my memoir on the Cephalopoda of the Muschelkalk (l. c. p. 28, Pl. V, fig. 7), is certainly not the inner nucleus of *Keyserlingites Dieneri*, but an independent species. Its transverse section differs considerably from inner nuclei of *K. Dieneri* of equal size. Nor does the shape of spines agree exactly in the two species.

2. KEYSERLINGITES PAGODA nov. sp. Pl. X, fig. 2.

From the lower Muschelkalk north of Po (coll. Krafft) a specimen is lying before me, which belongs to a species of *Keyserlingites* very nearly allied to *K. Dieneri*, but distinguished from it by slight differences in the ornamentation of the body-chamber volution and by the enormous width of its peristome.

The penultimate volution and the anterior portion of the last (body-chamber) whorl with the peristome have been preserved. The penultimate whorl agrees exactly with that of the specimen of *K. Dieneri* illustrated on Pl. XI, fig. 2. The last volution is very strongly inflated and trumpet-shaped. Its transverse section is hexagonal, the primary spines coinciding with the greatest width of the shell and the marginal spines with the obtusely rounded siphonal angles. The spines are not stout and bulky as in *K. Dieneri*, but are rather acute and elongated elevations of the strong ribs.

In my type-specimen the peristome has been preserved almost entirely. It is not preceded by any constriction of the shell. The apertural margin follows in its lower portion the direction of the lateral sculpture, being most strongly protracted in the umbilical region, and crosses the siphonal area in a nearly straight line, which unites with the lateral lappets in a forward-bent curve.

Thus, a deep sinus is formed in the siphonal area of the apertural margin contrasting remarkably with the shape of the peristome in Alpine and German *Ceratitidæ*. It shows a distant resemblance with the peristome of some *Nautilidæ* such as the Triassic *Pleuronautilus Rollieri* v. Arthaber (Cephalopoden der Reiflinger

Kalke, Beitræge zur Geol. u. Palæont. Oesterreich-Ungarns, etc., Bd. X, 1859, Taf. I, fig. 5), which has also its border strongly protracted in the umbilical region and is provided with a lateral and siphonal sinus. But the lateral sinus is very large, the siphonal one comparatively small in *Pleuronautilus Rollieri*, whereas in *Keyserlingites pagoda* the lateral sinus between the umbilical and lateral lappets of the apertural margin is very shallow, but the siphonal sinus is extraordinarily broad and deep.

Dimensions.

Diameter of the shell	cca.	100 mm.
" " " umbilicus		22 "
Height of the last volution		47 "
Thickness " " " "		75 "

Sutures.—Not known in detail.

3. Keyserlingites sp. ind. ex. aff. Bungei Mojs. Pl. XI, fig. 3.

A fragmentary body-chamber volution of *Keyserlingites* from the lower Muschelkalk of Lilang (coll. Krafft) is mentioned here on account of its remarkable similarity with *Keyserlingites Bungei* v. Mojsisovics (Ueber einige Arktische Triasammoniten des noerdlichen Sibirien, Mém. Acad. des sciences de St. Pétersbourg, XXXVI, No. 5, p. 8, Taf. I, fig. 14) from the mouth of the Olenek.

The volution is thicker than high, square in section with flattened lateral parts, which are separated by rounded margins from a high and steeply-curved umbilical wall, and from a broadly-vaulted siphonal area. The stout primary spines are not situated along the umbilical margin, but—exactly as in *Keyserlingites Bungei*—below the middle of the flanks. They are radially elongated and connected with low ribs, which run towards the umbilical and siphonal margins. The ribs are neither equidistant nor of equal strength. They become obsolete before reaching the umbilical suture, but are elevated into distinct tubercles along the siphonal margin. Some of the ribs bifurcate in the primary spines, the rest remain undivided. The siphonal area is crossed by ribs, connecting the marginal tubercles, but this siphonal ornamentation is much more delicate than the lateral sculpture.

The irregularity of sculpture in this fragment is easily explained, if we take into consideration that we have probably to deal with the anterior part of the body-chamber, preceding the peristome, where the normal sculpture is always subject to slight variations in full-grown individuals.

In designating the present species as *Keyserlingites sp. ind. aff. Bungei* I only wish to allude to its external similarity with this Siberian form, without suggesting any real affinity.

Dimensions.—As the fragmentary state of preservation does not allow any exact measurements of this specimen, I must refer the reader to the figure. The proportion of height and thickness near the aperture is 19 : 22 mm.

Sutures.—Not known.

4. KEYSERLINGITES nov. sp. ind. Pl. XI, fig. 4.

In the Himálayan collection this species is represented by a single fragment from the lower Muschelkalk of Lilang (coll. Krafft), from which it is impossible to take exact measurements.

There is especially an unnamed species from the mouth of the Olenek, described and illustrated by E. v. Mojsisovics (Arktische Triasfaunen, l. c. p. 48, Pl. II, fig. 14), to which the present fragment might be compared. It has numerous, narrow, partly acute ribs. The spines are faintly developed, not stout, but radially elongated in the direction of the ribs, some of which are dichotomous. Traces of marginal spines are but indistinctly developed.

Sutures.—Not known.

5. KEYSERLINGITES PAHARI nov. sp. Pl. VIII, fig. 2.

This interesting species is represented by a single but beautifully preserved specimen from the lower Muschelkalk of Lilang, Spiti (coll. Krafft). It consists almost entirely of air-chambers only.

In its general shape and involution this species agrees with *Keyserlingites subrobustus* Mojs. from which it is, however, distinguished by its richer ornamentation. The inner volutions are regularly rounded as far as they are exposed within the wide and very deep umbilicus. In the last volution the transverse section becomes square. The high umbilical wall still continues to be regularly rounded, but the lateral parts are flattened and converge slightly from the umbilical to the siphonal margin. The siphonal margin forms a distinct although obtusely rounded-off demarcation between the flanks and the siphonal area, which is very flatly vaulted.

In the inner volutions the only element of sculpture consists of stout tubercles which coincide with the greatest transverse diameter of the whorls, exactly as in *K. subrobustus*. It is only a matter of convenience, whether one prefers to designate these spines as umbilical or lateral. The involution takes place exactly outside the spiral line of spines, which are consequently exposed within the umbilicus. In the penultimate whorl the spines are elongated radially into short ribs, which, however, do not reach further down than half-way between the spines and the umbilical suture.

Thirteen primary spines are counted in the last volution. From each of them lateral ribs bifurcate regularly. Every rib terminates in a stout tubercle near the siphonal margin. The remarkable development of numerous marginal tubercles imparts to this species its characteristic shape. The ribs, which cross the siphonal area connecting a pair of marginal tubercles, are but faintly marked.

Dimensions.

Diameter of the shell	104 mm.
" " " umbilicus	32 "
Height of the last volution	42 "
Thickness " " "	56 "

Sutures.—Not entirely known. Agreeing in general with those of *K. Dieneri.*

Genus: BEYRICHITES Waagen.

In accordance with Waagen (Ceratite Formation, Salt Range Foss. Pal. Ind., ser. XIII, Vol. II, p. 160) the genus *Beyrichites* is accepted here as including the group of *Ceratites reuttensis* Beyrich (Ueber einge Cephalopoden aus dem Muschelkalk der Alpen, etc. Abhandl. kgl. Akad. d. Wissensch. Berlin, 1866, p. 113), which in 1882 had been united by E. v. Mojsisovics with Hyatt's genus *Meekoceras.*

Beyrichites has been placed in the family of *Ptychitidæ.* K. v. Zittel (in his Grundzuege der Palæontologie, second edition, 1903, p. 436) follows this view, whereas the genus is grouped among the *Meekoceratidæ* by Hyatt (in Zittel's textbook of palæontology, English edition, 1900, p. 556). In my memoir on the Cephalopoda of the lower Trias of the Himálayas (p. 73) I have strongly insisted on the character of the sutures and on the mode of development of *Beyrichites* excluding any attempt to establish a close relationship with *Ptychites,* in spite of the external similarity with the group of *Ptychites flexuosi.* I have the satisfaction of finding Philippi among the advocates of my view, and I fully agree with his opinion, that *Beyrichites* and *Ceratites* are very nearly allied and that their similarity is not due to convergence but to phylogenetic affinity.

In the Indian Muschelkalk the genus *Beyrichites* is represented by the following species:—

Beyrichites Khanikofi Oppel.
Beyrichites proximus Oppel.
Beyrichites Kesava Diener.
Beyrichites affinis Mojs.
Beyrichites Nanda Diener.
Beyrichites Gangadhara Diener.
Beyrichites Rudra Dien.

All these species are characterised by strongly involute, compressed whorls, with a highly rounded siphonal part, by the development of folds with a crescentic external portion, and by their frequent combination with elongated tubercles at their commencement in the middle of the lateral parts. In the sutural line, which is often brachyphyllic, the small size of the siphonal saddle in proportion to the principal lateral saddle is a good and constant character of the genus.

No new species of this genus has been noticed in the Himálayan collections recently examined. Of the following species representatives have been met with:

1. BEYRICHITES KHANIKOFI Oppel.

1865. *Ammonites Khanikofi* Oppel, Palæontologische Mitteilungen I, p. 275, Pl. 76, fig. 4.
1895. *Meekoceras Khanikofi* Diener, Cephalopoda of the Muschelkalk, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, p. 41, Pl. VIII, fig. 3, IX, figs. 1-3, 9.

Numerous examples of this species, one of the most important leading fossils of the Himálayan Muschelkalk, have been collected near Muth and Kágá, Spiti, by Hayden and in the Shalshal and Bambanag cliffs by A. v. Krafft.

I have nothing to add to my description of the species in the above-quoted memoir.

2. BEYRICHITES KESAVA Diener.

1895. *Meekoceras Kesava* Diener, Cephalopoda of the Muschelkalk, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, p. 43, Pl. VIII, fig. 6.

A specimen from the Muschelkalk of Kágá, Spiti (coll. Hayden), must be separated from *Beyrichites Khanikofi* Oppel on account of its very deep and narrow umbilicus and the absence of any disjunction of the spiral line. The latter feature is so much the more characteristic, as the present example does not consist of air-chambers only, but is provided with a large portion of its body-chamber. In both features and in the strongly-marked brachyphyllic serration of its sutural elements, it agrees with *Beyrichites Kesava*.

3. BEYRICHITES PROXIMUS Oppel.

1865. *Ammonites proximus* Oppel, Palæontologische Mittheil. aus dem Museum des bayr. Staates I, p. 291, Pl. 83, fig. 1.

1895. *Meekoceras proximum* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 44, Pl. VIII, fig. 2.

In 1895 one single specimen of this species—Oppel's type-specimen from Kangra (coll. Schlagintweit)—was known to me. A second well-preserved specimen has been discovered among Hayden's materials, collected in the Muschelkalk of Muth, Spiti.

It is considerably larger than Oppel's type-specimen, reaching a diameter of 72 mm. and being provided with its body-chamber. The characters of the full-grown individuals do not agree in every respect with the diagnosis of the smaller, entirely chambered example from Kangra. The peculiar transverse section, which is characteristic in Oppel's type-specimen, does not persist throughout all stages of growth. In the present example it is well marked at the beginning of the last volution only, but then gradually loses its arrow-shaped outlines and becomes more regularly cordiform. Then the aperture no longer differs from that in *Beyrichites Khanikofi* or *B. Kesava*.

The egression of the spiral of involution along the umbilical suture is distinctly marked. The umbilical margin, which is sharpened into an edge in the inner volutions, becomes regularly rounded in the body-chamber whorl.

Strong lateral tubercles make their first appearance, the last volution reaching a height of 28 mm. They increase in size towards the aperture, and keep their position exactly in the middle of the lateral parts. The crescent-shaped folds in the upper portion of the sides are but faintly marked in the last volution.

Sutures.—The very broad auxiliary saddles with flattened tops are a good character of the sutural line, which otherwise is nearly identical with that in *B. Khanikofi*.

4. BEYRICHITES cf. RUDRA Diener.

1895. *Meekoceras Rudra* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II. Pt. 2, Cephalopoda of the Muschelkalk, p. 50, Pl. X, fig. 1.

A large, entirely chambered specimen, from the ridge between Dharma and Lissar valleys (coll. La Touche), exhibits the remarkable circular arrangement of the sutural elements peculiar to *Beyrichites Rudra*. The sutural line is identical, with the sole exception that the number of auxiliary lobes and saddles is smaller than in my type-specimen from the Shalshal cliff.

A more important difference is the larger size of the umbilicus, which is bordered by a perpendicular wall meeting the lateral parts in a sharp edge. As my type-specimen was a rather fragmentary cast, which did not permit of exact measurements, it is difficult to decide whether or not this difference in the width of the umbilicus is sufficient to exclude a specific identification.

The surface of the shell is covered with a small number of low and broad falciform folds, which are most distinctly developed in the middle portion of the flanks.

Genus: CUCCOCERAS nov. gen.

In 1873 two ammonites from the white crinoid limestone (lower Muschelkalk) of Monte Cucco, Italian Alps, were described as *Trachyceras cuccense* and *T. Taramellii* by E. v. Mojsisovics (Ueber einige Triasversteinerungen aus den Suedalpen, Jahrb. K. K. Geol. Reichsanst., p. 428, 429, Taf. XIII, fig. 1, 2). In 1882 they were transferred to the genus *Dinarites* by the same author (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 11). But E. v. Mojsisovics himself remarks, that the propriety of placing them in this genus is questionable, on account of their peculiar sculpture, distinguished by the presence of numerous constrictions, and the imperfect knowledge of their sutural lines. In 1892 two more species, nearly allied to *Dinarites* (?) *cuccensis* Mojs. were discovered in the Bosnian Muschelkalk of Han Bulog by F. v. Hauer (Denkschr. Kais. Akad. d. Wiss. LIX, p. 259), and described as *D. labiatus* and *D. ornatus*. The second species perhaps represents only a juvenile stage of *Balatonites*, but *D. labiatus*, which has been referred to the genus *Dinarites* with great reserve by F. v. Hauer, has strong constrictions of the same character as the species from Monte Cucco.

In the Himálayan Muschelkalk this group of ammonites with numerous and strong constrictions and with less than the normal number of ceratitic sutures, is also represented by a species closely allied to *Dinarites* (?) *cuccensis* Mojs. F. v. Hauer pointed out the advisability of introducing a new genus for the accommodation of this peculiar group of *Ceratitoidea*. My opinion is, that all the forms mentioned differ from *Dinarites*, *Ceratites*, *Balatonites* or *Trachyceras* so considerably and in such essential features, that they cannot be included in any of those genera. I consider them as representatives of a new genus, for which the name of *Cuccoceras* is here proposed.

Cuccoceras Yoga nov. sp. Pl. III, fig. 7, Pl. IX, fig. 4.

No complete example of this species has been found among the Himálayan materials collected from the Muschelkalk of Muth, Spiti, by Hayden. But the number of fragments is so considerable, that from their combination a fairly good idea of all its characteristic features can be gathered.

The shell is disciform, very strongly compressed, provided with a large umbilicus and with slowly-increasing whorls, which overlap one another but very slightly. The transverse section is a long oval and twice as high as broad. The lateral parts are very regularly and flatly convex and are not separated from the flattened but narrow siphonal area. The umbilical margin is more distinctly marked and bordered by a low and steep umbilical wall.

The most prominent character of the sculpture, which is best preserved in the body-chamber fragment illustrated on Pl. III, fig. 7, is the presence of numerous and deep constrictions, which must probably be considered as paulostome furrows. They are broad, regularly-rounded, radial, with a forward-turned curve in the marginal region, showing direct imbrication. They attain their greatest depth in crossing the siphonal area. They do not occur at regular distances. In the intervals between the constrictions one, two or even three ribs are noticed, which in their direction follow the paulostome furrows. They are either simple or originate in pairs near the umbilical margin. Most of them are adorned by small tubercles situated in the middle of the lateral parts. The ribs are not interrupted along the siphonal area, but the intercostal valleys are considerably lower than the paulostome furrows.

Dimensions.

Diameter of the shell	54	mm.
„ „ „ umbilicus	26·5	„
Height of the last volution	16·5	„
Thickness „ „ „	9	„

Sutures.—The projection of the periphery of the penultimate whorl touches the outer margin of the second lateral saddle. Two lateral lobes, which are serrated at their base. Siphonal lobe short, bifid, with a low median prominence. Siphonal saddle broadly-vaulted, lateral saddles slender. The inner margin of the second lateral saddle coincides with the umbilical suture. No auxiliary lobes developed.

Remarks.—The present species is very nearly allied to *Cuccoceras cuccense* Mojs. In its sculpture it exhibits a remarkable similarity with the specimen illustrated by E. v. Mojsisovics in Vol. XXIII of the Jahrb. K. K. Geol. Reichsanst. The two species are, however, easily distinguished by the difference in their involution. The sutures of the three Alpine species from Monte Cucco are not known, but *Cuccoceras labiatum* Hauer from the Bosnian Muschelkalk agrees with our Himálayan form in the arrangement of the sutural line, which consists of two lateral lobes and saddles only.

Genus: BUKOWSKIITES nov. gen.

The only representative of this genus recalls the upper Triassic genus *Ectolcites* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-2, p. 613), by its strongly evolute whorls and by the presence of a deep, median siphonal furrow. Its sutures are brachyphyllic or slightly dolichophyllic. A remarkable character of the sutural line is the high position of the second lateral lobe and the very deep position of the auxiliary series. In the character of its sutures the genus appears to be most nearly allied to the genus *Japonites* Mojs.

BUKOWSKIITES COLVINI nov. sp. Pl. XVII, fig. 4.

The only specimen available for description, from the Muschelkalk of Jolinka, Byans (coll. Smith), is of obliquely elliptical shape, agreeing in this respect with the majority of specimens collected from that locality. It consists of very numerous whorls, overlapping one another scarcely to one-third of their height, thus leaving a wide umbilicus open. The greatest thickness of the lenticular transverse section is situated a little below the middle of the lateral parts. The volutions are higher than wide and provided with a rounded siphonal area, which is deeply excavated along its median line. The median sulcus is rounded at its base, but separated from the adjoining portions of the siphonal area by sharp edges, which, however, are not elevated. This is exactly the pattern of siphonal ornamentation that has been described for the genus *Ectolcites* by E. v. Mojsisovics. By breaking my type-specimen open I have been able to prove the presence of a sulcus at early stages of growth.

Otherwise the surface of the shell is nearly flat. Indistinct traces of radial ribs only are noticed on the inner volutions.

Dimensions.

Diameter of the shell	64	mm.
„ „ „ umbilicus	34·5	„
Height of the last volution	16·5	„
Thickness „ „ „	13	„
Height of the last volution in the place of its greatest applanation	12	„
Thickness „ „ „ „ „ „ „ „ „	11·5	„
Corresponding diameter of the shell	43	„
„ „ „ „ umbilicus	22	„

Sutures.—Similar to those of *Japonites*, exhibiting transitional shapes from a brachyphyllic to a dolichophyllic stage of development.

Siphonal lobe short, with a high median prominence, as in *Japonites Sugriva* Diener (Palæont. Indica, Himálayan Foss., ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 32, Pl. VII, fig. 1). The principal lateral lobe and the auxiliary series stand at an equal level. The second lateral lobe is considerably shorter. Principal lateral lobe terminating in a central point. Saddles more strongly serrated along their external walls than along their inner ones. Auxiliary saddles rudimentary, forming a long umbilical lobe, which is separated very sharply from the second lateral saddle. Second lateral saddle provided with a phylloid prominence at its inner margin as in *Japonites Sugriva.*

Genus : JAPONITES Mojsisovics.

Japonites, which in 1893 had been considered as a special sub-genus of *Ceratites* by E. v. Mojsisovics, was removed from the *Ceratitidæ* in 1902 by the same author (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, Supplement, p. 323) and elevated to the rank of a proper genus. I am inclined to follow this view, without entering into a discussion of the question of its systematic position among the family of *Ceratitidæ* or of *Meekoceratidæ*.

A complete diagnosis of the genus has been given in my memoir on the Cephalopoda of the Himálayan Muschelkalk (Palæont. Indica, ser. XV, Vol. II, Pt. 2, p. 31). The results of more recent studies do not necessitate any correction of this diagnosis, although the number of species has increased considerably.

In 1895 altogether four species of *Japonites* were known to me, one (*J. planiplicatus* Mojs.—the prototype of the genus) from beds of ladinic age in Japan, and three (*J. runcinatus* Oppel, *J. Chandra* Dien., *J. Sugriva* Dien.) from the Indian Muschelkalk. A species from the lower Muschelkalk of the Triassic limestone crag of Chitichun No. 1, described by myself as *Gymnites Ugra*, has been placed in the genus *Japonites* by E. v. Mojsisovics, who laid special stress on the importance of the sutural line, which agrees exactly with the sutures of typical *Japonites*

With this view I fully agree, considering the external resemblance with *Gymnites* as a case of convergence merely. I am now able to signalize three more European species which have been hitherto mistaken for either *Sybillites* or *Gymnites*, but must undoubtedly be placed in the genus *Japonites*.

One of those species was described in 1896 by F. v. Hauer from the Bosnian Muschelkalk of Haliluci as *Sybillites planorbis* (Beitræge zur Kenntniss der Cephalopoden aus der Trias von Bosnien, II, Nautileen und Ammoniten mit ceratitischen Loben aus dem Muschelkalk von Haliluci, Denkschr. Kais. Akad. d. Wissensch., XII, p. 271, Taf. XII, fig. 1—8). F. v. Hauer remarks the external similarity of his species with *Anagymnites acutus*, but correctly infers that the difference of their sutural lines excludes any identification with a representative of the *Gymnitinæ*. With the upper Triassic genus *Sybillites* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI—2, p. 314) the Bosnian species has certainly nothing whatever to do. Not only are the inner whorls of *Sibyllites* distinguished by a strong sculpture, but also its sutures differ so remarkably from those of *S. Grohmanni* Mojs.—the only species of *Sibyllites* the sutures of which are entirely known—that it cannot be united with *Sibyllites*. On the other hand, its sutural line agrees exactly with that of typical *Japonites* by the presence of dolichophyllic principal saddles and of very low, reduced auxiliary elements. Nor does its external shape afford any reason why it should not be included in this genus.

Two very remarkable species of *Japonites* have have been described recently from the Muschelkalk of Boljevici in Montenegro by A. Martelli, who has mistaken them for representatives of the genus *Gymnites*. One of them, *Japonites anomalus* Martelli (Cefalopodi triasici di Boljevici presso Vir in Montenegro, Palæontographia Italica, Vol. X, Pisa 1904, p. 112, Pl. X, fig. 9) is very nearly allied to the Indian *J. Sugriva* Dien. The second species, *J. Dieneri* Martelli (l. c. p. 113, Pl. VIII, fig. 7), is probably identical with a species from the Muschelkalk of Spiti.

1. JAPONITES CHANDRA Diener.

1895. *Japonites Chandra* Diener, Himálayan Foss., Palæont. Indica, ser. XV, Cephalopoda of the Muschelkalk, Vol. II, Pt. 2, p. 33, Pl. X, fig. 4.

Of this species a single but complete specimen from the Shalshal cliff was known to me in 1895. From the same locality a second example has been collected by A. v. Krafft, agreeing in size, shape and every detail of its external characters with my type-specimen. A third example, from the Muschelkalk south-east of Muth, Spiti (coll. Krafft), is of larger size, attaining a diameter of 100 mm., but its outer volution has been much injured and its surface is corroded by weathering.

In the sutural line the second lateral and first auxiliary lobes are on an equal level, whereas in the type-specimen the position of the lateral lobes is lower than that of the auxiliary series.

2. JAPONITES cf. UGRA Diener. Pl. VI, fig. 2.

1895. *Gymnites Ugra* Diener, Himál. Foss., Pal. Indica, Vol. II, Pt. 12, Cephalopoda of the Muschelkalk, p. 112, Pl. XXX, fig. 5.
1902. *Japonites Ugra* Mojsisovics, Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI—1, Supplement, p. 328.

A specimen of *Japonites* from the lower Muschelkalk north of Lilang (coll. Krafft) agrees very well with the type-specimen of *J. Ugra* from the Triassic limestone crag of Chitichun No. 1 (Tibet). It combines the external shape of *Gymnites* with the sutures of *Japonites*. The broad, transverse plications are more strongly marked, especially in the last volution, which is entirely chambered. A chain or raised band of tubercular prominences, bordering the terminations of the folds along the middle of the sides, has not been noticed.

Sutures.—Agreeing exactly with those of my type-specimen of *J. Ugra*.

Dimensions.

Diameter of the shell	62 mm.
" " " umbilicus	23 "
Height of the last volution	24 "
Thickness " " "	12 "

3. JAPONITES cf. DIENERI Martelli. Pl. X, figs. 1, 2.

1904. *Gymnites Dieneri* Martelli, Cefalopodi triasici di Boljevici presso Vir nel Montenegro, Palæontographia Italica, Vol. X, p. 118, Pl. VIII, fig. 71.

In 1904 a typical representative of the genus *Japonites* was described from the Muschelkalk of Boljevici in Montenegro by Martelli, who erroneously placed it in the genus *Gymnites* notwithstanding the difference in the arrangement of the sutural line. With this species a small number of specimens of *Japonites* from the Muschelkalk of Kágá, Spiti (coll. Hayden) can probably be identified.

In their dimensions all of them agree exactly with the European form. The illustrated specimen is a fragment of the two last volutions adhering to the impression of the complete specimen in the rock. By making a plaster-cast of this impression and by joining it to the fragment, I have succeeded in reconstructing the entire specimen.

The species has very numerous, slowly-increasing whorls, which overlap each other scarcely to the third part of their height. The transverse section is helmet-shaped, the lateral parts converging from the umbilical margin towards the sharpened siphonal part in graceful curves. In two of my specimens—the type-specimen included—the transverse section is strongly compressed, exactly as in the specimen from Boljevici. In a third example, however, the whorls are more strongly inflated, being only a little higher than broad. This example differs from the type by a stouter ribbing, but neither features appears to me of sufficient importance to be regarded as of more than varietal value.

The lateral parts of the volutions are covered with straight, equidistant ribs, recalling the sculpture of liassic *Arietidæ*. In the penultimate whorl 33 ribs are counted. In the body-chamber the ribs are less strongly developed. They do not extend as far as the siphonal edge, but gradually die out in the upper portion of the flanks. Within the umbilicus the smooth area of the flanks is hidden by the involution of the whorls.

Dimensions.

Diameter of the shell		126	mm.
„ „ „ umbilicus		65	„
Height of the last volution	above the umbilical suture	35	„
	„ „ preceding whorl	30	„
Thickness of the last volution		21	„

Sutures.—The sutural line is excellently preserved in the example belonging to the variety with inflated whorls and coarser ribs. It has therefore been chosen for illustration.

Sutures dolichophyllic, agreeing with those in *Japonites Sugriva* Diener (Cephalopoda of the Muschelkalk, Himál. Foss., Palæont. Indica, ser. XV, Vol. II, Pt. 2, p. 32, Pl. VII, fig. 1). Siphonal lobe short, but broader than in *J. Sugriva* and divided by a high median prominence. Siphonal and principal lateral saddles of equal height. Second lateral saddle with a phylloid prominence at its inner margin.

Auxiliary series of rudimentary lobes placed lower than the second lateral lobe which is very short.

The sutural line of my Himálayan example does not agree in its details with the illustration of the sutures of *Japonites Dieneri*, from Boljevici, published by Martelli (l. c. p. 113). But I have grave doubts as to the correctness of this figure. The reproduction of the siphonal prominence is certainly erroneous. Taking into consideration the large number of misinterpretations which can be pointed out in Martelli's memoir, his figures of the sutural lines of both *J. Dieneri* and *J. anomalus* can be accepted only with the greatest reserve.

Martelli's type-specimen not being available to me for comparison, I must abstain from a direct identification of my Himálayan species with *J. Dieneri*, although the absolute agreement of their external characters does speak strongly in its favour.

Sub-genus: *PSEUDODANUBITES* Hyatt.

1900. *Pseudodanubites* Hyatt, "Cephalopoda" in Zittel's Text-book of Palæontology, English edition, p. 757.

In my memoir on the Cephalopoda of the Indian Muschelkalk a species from the Muschelkalk of the Uta-dhura (Kumaon) was described as *Danubites Dritarashtra*. A. v. Krafft (General Report, Geological Survey of India for 1898-99, p. 20) believed this species to belong to *Japonites* rather than to *Danubites*. He considered his view to be justified by the following facts:—

"One of the species of *Japonites* in Hayden's collection consists of very slowly-increasing whorls, only slightly overlapping each other; the sides are covered with strong, radial ribs which are dying out near the siphonal edge, where some of them are found to bifurcate. The septa are very distant from each other, the saddles unusually broad, the first auxiliary lobe coincides with the umbilical margin. For the rest, the sutures are similar to those of other species of *Japonites*, especially in the shortness of the second lateral lobe. I believe this species of *Japonites* to be identical with the specimen described as *Danubites Dritarashtra*, by Prof. Diener. There are but two differences noticeable. Diener's type-specimen shows unincised saddles, while in the *Japonites* under consideration the saddles are incised. Besides this, the auxiliary lobe is shorter in Diener's type-specimen than in the latter.

"Unfortunately I did not succeed in developing the sutures of the inner whorls of this *Japonites*, and thus further researches as to the correctness of my supposition are impossible. For this reason I abstain from changing the present nomenclature, hoping that further researches will reveal more specimens from which it will be possible to decide the question."

Among the representatives of the genus *Japonites*, in Hayden's Himálayan collection, I have not met with a single specimen whose identification with *Danubites Dritarashtra* might earnestly be taken into consideration. All the examples covered with strong ribs are provided with an acute siphonal crest, which makes their distinction from *D. Dritarashtra* an easy matter. All of them are, moreover, distinguished by dolichophyllic saddles, contrasting very remarkably with the entire saddles of the latter species.

According to my view, the difference in the character of the sutural line does not allow *D. Dritarashtra* to be placed among the representatives of the genus *Japonites*. On the other hand, in the shape and involution of the shell the resemblance to *Japonites* is, indeed, greater than to *Danubites*. In some of its features *D. Dritarashtra* slightly differs from typical species of *Danubites* or rather of *Florianites* Hyatt. I am, therefore, inclined to follow Hyatt in considering it as the prototype of a new sub-genus, *Pseudodanubites*.

As sub-generic features the following might be enumerated: the very large number of slowly-increasing whorls, the obtuse median edge of the siphonal area, which is, however, not sharpened, the combination of deeply-incised lobes and of entire and broad saddles in the distant septa. It is chiefly the shape of the transverse section in which *Pseudodanubites* differs from *Danubites* Mojs., whereas it is distinguished from *Japonites* by the simpler character of its sutural line.

PSEUDODANUBITES DRITARASHTRA Diener. Pl. VI, fig. 3.

1895. *Danubites Dritarashtra* Diener, Himálayan Fossils, Palæont. Indica, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 30, Pl. VIII, fig. 1.

Of this species a small number of fragments were collected by La Touche in the Muschelkalk of the ridge between the Dharma and Lissar valleys. As I have stated in my description, the front-view of the type-specimen from the Utadhura does not give a correct idea of its shape, the specimen being slightly distorted and so drawn out that its siphonal part looks rather unnaturally sharpened.

The examination of the fragments collected by La Touche fully confirms this supposition. The lateral parts are strongly convex and unite in an obtuse edge, along which is a thin thread-like keel.

The oblique, elliptical shape is peculiar to all specimens examined and does not appear to be due to deformation through pressure.

Genus: STACHEITES Kittl.

1903. *Stacheites* Kittl, Die Cephalopoden der oberen Werfener Schichten von Muć in Dalmatien, Abhandl., K. K. Geol. Reichsanst., XX Bd., Heft 1, p. 27.

STACHEITES WEBBIANUS nov. sp. Pl. V, fig. 6.

Our knowledge of the lower Triassic genus *Stacheites* is rather fragmentary. The genus has been proposed by Kittl for the accommodation of a single, imperfectly preserved specimen from the upper Werfen beds of Muć. This specimen, the only representative of the only species, *Stacheites prionoides* Kittl (l. c. p. 27, Taf. IV, fig. 8), is a discoidal shell with a narrow umbilicus and with a sutural line recalling *Dinarites*. The shell has been much deformed by weathering and by pressure.

Its surface was apparently smooth. The presence of two external edges bordering the siphonal area is probable, but has not been ascertained.

In placing a Himálayan species in the genus *Stacheites*, I do so with all the reserve due to the insufficient diagnosis of this genus. My species also is represented by a single specimen only, collected by A. v. Krafft in the lower Muschelkalk of Lilang (Spiti). Although not complete, it is certainly better preserved than Kittl's type-specimen of *St. prionoides*. It is chiefly on account of its sutural line and of its involution that I feel obliged to include it in the genus *Stacheites*. There is no other Triassic genus known to me, in which so narrowly umbilicated shells are provided with less than the normal number of lobes.

In general shape and involution the present species recalls the genus *Proavites* v. Arthaber (Cephalopoden der Reiflinger Kalke, Beitræge zur Palæont. und Geol. Oesterreich-Ungarns etc., X, p. 104). The whorls overlap one another to a great extent, leaving only a narrow umbilicus open. At the beginning of the last volution the high umbilical wall is perpendicular and separated sharply from the flanks by an obtusely-rounded edge. In the vicinity of the aperture the umbilical wall is gradually turned into a steep slope, which passes into the lateral parts in a gradually rounded curve. The lateral parts are nearly flat and separated from the flattened siphonal area by marginal edges. The greatest transverse diameter occurs in the vicinity of the umbilical region. From this place the lateral parts converge regularly towards the marginal edges.

The surface is not entirely smooth, but is covered with very numerous and delicate spiral striæ. This ornamentation, which is only noticed in places where the shell has not been injured by weathering, recalls the genus *Flemingites* Waagen.

In the present specimen exactly one-half of the last volution belongs to the body-chamber.

Dimensions.

Diameter of the shell	42	mm.
„ „ „ umbilicus	6	„
Height of the last volution	22·5	„
Thickness „ „ „	17	„

Sutures.—A comparison of the sutural line of the present species with *Proavites Hüffeli* Arthaber, *P. marginatus* Arth. and *P. avitus* Arth. shows, that there is no affinity between them notwithstanding their external resemblance. *Stacheites Webbianus* has less than the normal number of lobes, but the denticulation of the lobes is rather strongly developed.

Siphonal lobe short, not occupying the siphonal area entirely, with a small median prominence and with a secondary indentation at the base of the siphonal saddle. Lateral lobe broad and with deep denticulations. A secondary indentation occurs at the base of the inner margin of the siphonal saddle. The lateral saddle is also bordered by a corresponding secondary indentation along its low inner margin.

Auxiliary lobe flat, faintly serrated and accompanied by a flatly arched saddle, which is divided by the umbilical suture.

Genus: DALMATITES Kittl.

1903. *Dalmatites* Kittl, Die Cephalopoden der oberen Werfener Schichten von Mue in Dalmatien, Abhandl., K. K. Geol. Reichsanst., XX Bd., Heft 1, p. 73.

DALMATITES ROPINI nov. sp. Pl. IX, figs. 5, 6.

A species from the Alpine Werfen beds of lower Triassic age, showing a strong external resemblance to *Hungarites*, but differing in the arrangement of its sutural line by the small number of its elements, has been considered as the prototype of a proper genus by Kittl. With this species, *Dalmatites morlaccus* Kittl (l. c. p. 73, Taf. IV, figs. 4-7), a species from the lower Muschelkalk of the Himálayas agrees so closely that their specific separation can be based only on very subordinate characters.

The shell is discoidal and very strongly involute. The whorls overlap each other almost entirely, the umbilicus being extremely narrow. The overlap of the last whorl over the preceding one amounts to more than one-third of the entire height of the former. The low umbilical wall is perpendicular and separated from the flat lateral parts by a distinct edge, whereas the umbilical margin is rounded in *Dalmatites morlaccus*. The lateral parts are almost flat. The greatest diameter of the transverse section is situated in the middle of the sides in younger and adolescent stages of growth, but is gradually shifted towards the external region in adult individuals. This character is also noticed in the example of *D. morlaccus* illustrated in fig. 5, Pl. IV of Kittl's memoir. The flanks meet in a sharp median edge. This median edge is never accompanied by marginal edges, as in *Hungarites*. Even the faintly indicated siphonal margins, which have been noticed by Kittl in some of his specimens of *D. morlaccus*, are entirely absent in my examples. In its external shape therefore, our Himálayan species very strongly recalls the genus *Longobardites* Mojs. It was only the examination of the sutural line which peremptorily excluded any identification.

The surface of the shell is almost entirely smooth. Delicate falciform striæ of growth are occasionally visible in parts of the shell which are in a perfect state of preservation.

In one of my examples more than one-half of the last volution belongs to the body-chamber, although the peristome has not been preserved. Kittl stated the length of the body-chamber to be equal to two-thirds of the last whorl in some of his Alpine specimens of *D. morlaccus*.

Dimensions.

Diameter of the shell	37	mm.
" " " umbilicus	3	"
Height of the last volution { above the umbilical suture	18·5	"
Height of the last volution { " " preceding whorl	11	"
Thickness of the last volution	8	"

Sutures.—Sutures ceratitic, with faintly serrated lobes and entire saddles. The projection of the periphery of the penultimate whorl touches the top of the lateral saddle in the last volution. There is only one lateral lobe present.

The second lateral lobe, which must be considered as an auxiliary element according to the terminology of E. v. Mojsisovics and Waagen, is followed by a low and broadly vaulted saddle. The presence of a small umbilical lobe, as described in *Dalmatites morlaccus* by Kittl, could not be ascertained.

Siphonal lobe low and provided with a very broad median prominence. Each of its wings provided with a small number of indentations, not terminating in a single point as in *D. morlaccus.*

Locality: number of specimens examined.—This species seems to be rather common in the lower Muschelkalk of Lilang, Spiti, where ten specimens have been collected by A. v. Krafft. One specimen has been noticed among A. v. Krafft's collections from the lower Muschelkalk of the Bambanag cliff (horizon of *Spiriferina Stracheyi*).

Genus: TRACHYCERAS Laube.

Sub-genus: *PROTRACHYCERAS* v. Mojsisovics.

It is with great hesitation and with all reserve that two species of *Trachyceras* are quoted here in the description of the fossils from the Himálayan Muschelkalk. Their occurrence in the main mass of the Muschelkalk of Spiti is not beyond doubt. They were collected north-north-west of Kágá by Hayden. Hayden in his memoir on Spiti (Memoirs Geol. Survey of India, Vol. XXXVI., Pt. 1, p. 75) states the main mass of the Muschelkalk to pass quite gradually into the overlying beds of ladinic age. From these passage-beds there are a large number of ammonites among his collections which will be described in the third part of this volume. But he expressly quotes two species of *Trachyceras* as occurring in the main mass of the Muschelkalk. In describing these two species in the present monograph, which will contain a description of the fauna of the main mass of the Himálayan Muschelkalk only, excluding the fossils from the passage-beds of ladinic type, I am following the authority of the late A. v. Krafft, who strongly emphasizes their occurrence in the main mass of the Muschelkalk.

It is not the occurrence of the genus *Trachyceras* which appears to me as doubtful. I am well aware that the two sub-genera *Anolcites* and *Protrachyceras* have been previously met with in the Alpine Muschelkalk. A typical representative of *Protrachyceras* has been described by myself from the Muschelkalk of Hungary (Palæontologischer Anhang zum ersten Teil des ersten Bandes der Resultate der wissenschaftlichen Erforschung des Balatonsees, Neue Beobachtungen über Muschelkalk-Cephalopoden des südlichen Bakony, p. 11, Taf. II, fig. 2). The Bosnian species described as *Ceratites ecarinatus* by F. v. Hauer (Denkschr. Kais. Akad. d. Wiss., Bd. LXIII, p. 21, Taf. VIII, figs. 7-8) should also be included in the sub-genus *Protrachyceras.* But a species so strongly recalling ladinic types as does *Protrachyceras longobardicum* Mojs., is, indeed, a form which no palæontologist would expect in deposits of Muschelkalk age.

1. PROTRACHYCERAS CAUTLEYI nov. sp. Pl. XII, fig. 2.

1899. *Trachyceras nov. sp. ind. ex aff. T. Reitzi* A. v. Krafft, Gen. Peport, Geol. Surv. of India for 1898-99, p. 16.

The only specimen available for description belongs to the group of *Trachycerata subfurcosa* Mojs. A. v. Krafft was perfectly right in comparing it to *Protrachyceras Reitzi* Boeckh (Die geologischen Verhältnisse des südlichen Teiles des Bakony, Jahrb. Kgl. Ungar. Geol. Anst., p. 157, Taf. VII, fig. 3, Taf. VIII, figs. 3-5), to which species it is certainly very nearly allied.

The shell is widely umbilicated and consists of slowly-increasing whorls which overlap one another along their siphonal part only. The volutions are but little higher than broad, with an oval cross-section, and bordered by strongly arched lateral parts. The umbilical wall is very steep, but is not separated sharply from the flanks.

As in *Protrachyceras Reitzi*, the sculpture consists of strong ribs, which are simple as a rule, but rarely dichotomous in the middle of the flanks. The median furrow along the siphonal area is indicated rather by an interruption of the coarse lateral sculpture than by a depression or excavation in the shell. It is bordered by high and very strongly developed external spines, which are not arranged symmetrically on both sides. To every lateral rib an external spine corresponds, whereas in *P. Reitzi* the number of spines is smaller than that of ribs. Another difference between our species and *P. Reitzi* consists in the richer ornamentation of the lateral parts. In *P. Reitzi* the inner volutions only are adorned with marginal, lateral and umbilical spines, which gradually disappear in the last volution. In the last whorl of *P. Cautleyi* such spines are very distinctly developed, although as an element of sculpture they are inferior to the ribs.

The marginal and lateral spines are high and rise from a circular base. The umbilical spines are narrow and elongated radially. The ribs originate from the umbilical suture and run in a straight direction across the umbilical wall.

The involution takes place exactly outside the spiral of marginal tubercles, which are clearly exposed within the umbilicus in the penultimate whorl.

Dimensions.

Diameter of the shell	64 mm.
„ „ „ umbilicus	26 „
Height of the last volution	22 „
Thickness „ „ „	19 „

Sutures.—Not known.

Locality: number of specimens examined.—North-north-west of Kágá 1, coll. Hayden.

2. PROTRACHYCERAS cf. LONGOBARDICUM v. Mojsisovics. Pl. XII, fig. 1.

1882. *Trachyceras longobardicum* E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, Abhandl., K. K. Geol. Reichsanst., X, p. 126, Taf. XVIII, fig. 4, 5. Taf. XX, fig. 1, Taf. XXII, fig. 5.

1899. *Trachyceras aff. longobardicum* A. v. Krafft, General Report, Geol. Survey of India for 1898-99, pp. 16, 18.

A large specimen of ***Protrachyceras*** apparently agrees in all essential points of shape and sculpture so closely with one of the varieties of *P. **longobardicum***, illustrated by E. v. Mojsisovics, that I cannot find any reason for a specific separation.

My specimen shows a close resemblance to the example from Esino, illustrated by E. v. Mojsisovics on Pl. XXII, fig. 5 of his above-quoted monograph. It is high-mouthed and provided with a wider umbilicus than the typical form. There are numerous umbilical tubercles present. The number of secondary ribs, originating from repeated bifurcations of stem-ribs, is consequently smaller than in the type-specimens from the Wengen beds of the Bakony. In the typical form of *P. longobardicum* a nine-fold division of stem-ribs has been noticed by E. v. Mojsisovics. In my Himálayan specimen the number of ribs originating from a single stem-rib never exceeds five, but is usually reduced to three. A few ribs remain undivided. A similar proportion of stem-ribs to secondary ribs is exhibited in the specimen from Esino quoted above.

The number of spiral rows of tubercles is seven at the beginning and eight near the aperture of the last volution, which is still entirely chambered. The median furrow of the siphonal part is very deep. The external tubercles are clongated spirally and are arranged asymmetrically on either side of the shell.

Dimensions.

Diameter of the shell		97 mm.
„ „ „ umbilicus		17 „
Height of the last volution	above the umbilical suture	48 „
	„ „ preceding whorl	35 „
Thickness of the last volution		30 „

Sutures.—Agreeing with those of the typical form of *Protrachyceras longobardicum*. Saddles with serrated margins. The siphonal saddle is the largest. A very broad auxiliary lobe follows the second lateral saddle outside the umbilical edge. An auxiliary saddle is indicated in the vicinity of the umbilical suture.

Locality: number of specimens examined.—North-north-west of Kágá, Spiti, 1, coll. Hayden.

B. TROPITOIDEA.

Genus: ISCULITES Mojsisovics.

ISCULITES HAUERINUS Stoliczka.

1865. *Clydonites Hauerinus* Stoliczka, Memoirs. Geol. Surv. of India, Vol. V, Pt. 1, p. 50, Pl. IV, fig. 3.
1895. *Isculites Hauerinus* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 39, Pl. XXVII, fig. 3, XXXI, fig. 11.
1899. *Isculites Hauerinus* E. v. Mojsisovics, ibidem, Vol. III. Pt. 1, Upper Triassic Faunæ of the Himálayas, p. 40.
1899. *Isculites Hauerinus* A. v. Krafft, General Report, Geol. Surv. of India for 1898-99, p. 18.

The occurrence of this species in the Indian Muschelkalk was considered as doubtful by E. v. Mojsisovics and by myself, the genus *Isculites* being known only from stages of upper Triassic age in the Alpine region. No satisfactory account had been given by Stoliczka of the exact horizon of the deposits near Lilang, Spiti, in which his type-specimens had been found. This question has been solved by A. v. Krafft, who identified the species among the materials collected by Hayden in the Muschelkalk of Spiti in 1898. Three specimens from the Muschelkalk of Muth can be safely identified with Stoliczka's species agreeing in all their essential features with the type-specimen from Lilang. One of them, measuring 41 mm. in diameter, is the largest representative of the genus *Isculites* hitherto known. All three specimens are provided with their body-chambers and show the remarkable egression of the umbilicus, characteristic of *Isculites*. Their surface has partly suffered by weathering. Even in places where it has been fairly well preserved, it is almost entirely smooth, being covered with very delicate striæ of growth only.

Genus: SMITHOCERAS nov. gen

The systematic position assigned here to the type described under the specific name of *Smithoceras Drummondi* requires some words of explanation.

Smithoceras Drummondi belongs undoubtedly to the family of *Haloritidæ*, so widely distributed in the upper Triassic deposits of the Mediterranean and Indian provinces. It has brachyphyllic or doliohophyllic sutures, agreeing with those in the genus *Juvavites* Mojs. The body-chamber of the species is, unfortunately, not known to me, all specimens consisting of air-chambers only. In its general shape and involution the shell agrees with *Juvavites*, especially with forms belonging to the sub-genus *Anatomites*. As in *Anatomites*, contractions are noticed in the last volution. With *Anatomites crasseplicatus* Mojs., with *Isculites* and with many species of *Halorites*, *Smithoceras* agrees in the egression of its umbilicus. The only difference between this new genus and *Anatomites* is the absence of any sculpture. This character must be considered as a feature of generic distinction between *Smithoceras* and the rest of the *Juvavitinæ*.

Smithoceras and *Isculites Hauerinus* Stol. are the geologically oldest representatives of the *Haloritidæ* hitherto known. *Smithoceras* is probably the primitive ancestor of the more highly specialised types of *Juvavites* in upper Triassic deposits. The ammonite from the Shalshal cliff described and illustrated by myself as "*nov. gen. ind. ex. fam. Arcestidarum*" in Vol. II, Pt. 2, of the present series (p. 85, Pl. XXVIII, figs. 2, 3) is also a representative of the genus *Smithoceras*, as is proved by the agreement of their sutural lines. Its specific identity with *Smithoceras Drummondi* is doubtful. The specimen from the Shalshal cliff is too poorly preserved to allow more than the statement of its generic identity with *Smithoceras*. The examination of new materials has led me to the conclusion that *Smithoceras* cannot be included in the family of *Arcestidæ*, notwithstanding its external resemblance to *Joannites* and its smooth shell.

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SMITHOCERAS DRUMMONDI nov. sp. Pl. XII, fig. 3.

In its general shape this species very strongly recalls some forms of the genus *Ptychites*, especially of the group of *opulenti*. It is of globose shape and provided with a proportionately wide umbilicus. The section of the outer whorl is almost triangular. The transverse section is considerably broader than high. The maximum thickness coincides with the umbilical margin, from which the slightly convex sides converge towards the acutely rounded siphonal part. At an early stage of growth the siphonal part is broadly rounded, but becomes gradually sharper in later developmental stages.

The deep umbilicus is bordered by a steep inner wall. The umbilical margin is sharply rounded, especially so in the last volution, although not acute. In the inner whorls the involution takes place exactly at the umbilical margin, the inner volutions being only defined within the umbilicus by a screw-like spiral line. Near the aperture of the last whorl, however, which is still entirely chambered, the umbilical suture begins to leave the normal spiral. This egression recalls species of the genera *Isculites*, *Halorites* and *Anatomites*.

As my specimens are casts without any trace of their shelly substance preserved, the ornamentation of the shell is not known to me. The casts are entirely smooth. Four broad but very low contractions are noticed in the last volution.

Dimensions.

Diameter of the shell		63 mm.
" " " umbilicus		16 "
Height of the last volution	above the umbilical suture	24 "
	" " preceding whorl	13 "
Thickness of the last volution		44 "

Sutures.—Very similar to those of *Anatomites*. The type of sutures is the same as in *A. Bacchus* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI—2, p. 143, Taf. LXXXVII, fig. 20). The highly developed principal saddles contrast remarkably with the indifferently developed auxiliary elements. In inner nuclei with a diameter of 25 mm. the saddles are only brachyphyllic. In adult individuals they are dolichophyllic, but their indentations are never affected by secondary incisions.

The projection of the periphery of the penultimate whorl touches the top of the second lateral saddle in the last volution. The principal saddles show a serial arrangement, but the siphonal lobe is shorter than the principal lateral one. First auxiliary lobe broad and well individualised. It is followed by three small saddles, separated by narrow lobes.

Locality : number of specimens examined.—Jolinka (Byans) 2, coll. Smith.

Remarks.—In its general shape this species recalls a cast of a widely umbilicated *Anatomites*, devoid of its shell, as strongly as an inner nucleus of *Ptychites* of the group of *opulenti* or of *megalodisci*, but the character of the sutural line excludes any affinity with *Ptychites*. The present species must find its systematic position among the relatives of *Juvavites*, especially of the sub-genus *Anatomites*, from which it differs chiefly by its smooth shell and by the insignificant development of constrictions.

Genus : SIBIRITES Mojsisovics.

SIBIRITES PRAHLADA Diener.

1895. *Sibirites Prahlada* Diener, Himálayan Fossils, Palæont. Indica, ser. XV, Vol. II. Pt. 2, Cephalopoda of the Muschelkalk, p. 37, Pl. VII, fig. 5.

Four specimens of this beautiful species have been collected in the lower Muschelkalk of Lilang by A. v. Krafft. Although inner nuclei of *Ceratites* (*Keyserlingites*) *Dieneri* are very similar to *Sibirites Prahlada*, a distinction between them is possible on account of the different position of the spines, which in *S. Prahlada* are crescent-shaped and situated below the siphonal margin. Another point of difference is the arrangement of the sutural line, which is, however, difficult of access in all my examples of *S. Prahlada*, the last volutions of which belong entirely to the body-chamber.

Genus : ACROCHORDICERAS Hyatt.

1. ACROCHORDICERAS CF. CAROLINÆ v. Mojsisovics. Pl. XII, figs. 4, 5.

1882. *Acrochordiceras Carolinæ* E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X. p. 141, Taf. XXVIII, fig. 14, Taf. XXXVI, fig. 3.

1895. *Acrochordiceras undatum* G. v. Arthaber, Cephalopodenfauna der Reiflinger Kalke, I Theil, Beiträge zur Palæont. u Geol. Oesterr-Ungarns, etc. p. 79, Taf. VII, figs. 7, 8.

1896. *Acrochordiceras undatum* G. v. Arthaber, *ibid.*, II Theil, p. 235, Taf XXVII, fig. 2.

1899. *Acrochordiceras Damesi* A. v. Krafft, General Report, Geol. Surv. of India, 1898-99, p. 19.

All specimens of *Acrochordiceras*, collected in the Muschelkalk of Spiti by Hayden and A. v. Krafft, have been united by the latter author in a single species, which he identified with *A. Damesi* Noetling (Zeitschr. Deutsch. Geol. Ges. 1880, p. 334, Taf. XV) from the German Muschelkalk. In doing so he followed the lead of F. v. Hauer, who united all specimens of *Acrochordiceras* with umbilical tubercles from the Bosnian Muschelkalk in a single species, notwithstanding their great variability in shape and sculpture.

It has already been remarked by E. v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI—2, 1893, p. 843), that the identification of the Bosnian species with *Acrochordiceras Damesi* will not stand a severe test. Nor can I agree with A. v. Krafft in uniting his Himálayan specimens with the species from the German Muschelkalk. My examination of his materials has convinced me of the absolute impossibility of an identification of the Indian and German forms. My opinion is not based on the differences of sculpture, which have been enumerated by E. v. Mojsisovics. Those differences are, indeed, of secondary importance only, the variability among individuals being too great to allow a sharp boundary between the two species to be drawn in this respect. But there is a very marked difference in the character of the sutural line.

The most remarkable feature in the sutural line of *Acrochordiceras Damesi* is the extraordinary width of the principal lateral lobe, which is broader than deep. In none of the Alpine and Himálayan forms of *Acrochordiceras* has a similar development of this lobe been noticed. Nor do the lobes and saddles agree in their general shape. The saddles of the Alpine and Indian species are club-shaped, whereas in *A. Damesi* they converge regularly towards their tops. This essential difference in the sutures forbids, in my opinion, an identification of the Alpine and Indian types with Noetling's species from the German Muschelkalk.

The species to which most of the Himálayan examples are most nearly allied is *Acrochordiceras Carolinæ* v. Mojsisovics. If this species is taken in a somewhat wider range of circumscription than was suggested by E. v. Mojsisovics, there is no reason against an amalgamation of the Alpine and Indian forms under *A. Carolinæ*.

In the specimen illustrated, which ought to be considered as the typical form of the Himálayan variety, the whorls are of equal height and thickness; they enclose a deep and widely open umbilicus and embrace one another to about one-half their height. But in other specimens the rate of involution varies considerably, amounting to two-thirds of the entire height of the preceding whorl.

In the circumference of the last volution a variable number of umbilical tubercles—from four to nine—are counted, from which two, or exceptionally, even three bifurcating ribs originate. The number of simple, intermediate ribs without tubercles is two or three. In the bifurcating ribs the point of bifurcation is not always marked by an umbilical tubercle. As a rule umbilical tubercles are not developed before a diameter of 25 mm. has been attained by the shell. All the ribs reach their greatest elevation in the middle of the rounded siphonal area, which they cross without any interruption.

Dimensions.

Diameter of the shell	49 mm.
" " " umbilicus	13·5 "
Height of the last volution	22 "
Thickness " " "	22 "

In a fragment of very large size, consisting of air-chambers only, the measurements are as follows :—

Height of the last whorl	40 mm.
Thickness " " "	37 "
Diameter of the umbilicus	23 "

Sutures.—The sutural line has been especially well preserved in the large fragment quoted above. On account of its size, which nearly agrees with the dimensions of *Acrochordiceras Damesi* Noetl. and of the Bosnian type, illustrated by F. v. Hauer, it allows a closer comparison with those two species than the small type-specimen of *A. Carolinæ* figured by E. v. Mojsisovics. It agrees in general with the sutures of the Bosnian form as illustrated by F. v. Hauer (l. c. Taf. V. fig. 2 *c*), but differs from it in some details. Those differences chiefly affect the sutural elements inside the principal lateral saddle. The second lateral lobe is not bicuspidate, but is provided with a large number of unequal indentations. The adjoining saddle, which coincides with the umbilical tubercles, is of larger dimensions. The umbilical lobe is broader and deeper and not followed by any saddle. The brachyphyllic serration of all saddles is less distinctly developed.

The less remarkable width of the principal lateral lobe and the club-shaped character of the saddles are conspicuous features of distinction between the sutures of our Himálayan species and of the German *Acrochordiceras Damesi.*

It has been remarked by E. v. Mojsisovics, that in *A. Carolinæ* the position of the second lateral lobe is rather uncertain. In his specimens the projection of the periphery of the preceding whorl touches this lobe in the last volution in later stages of growth. It might consequently be equally well regarded either as a lateral or an auxiliary element. In my examples the spiral of projection is gradually shifted towards the inner side of the second lateral lobe in later stages of development, and, in my largest specimen it even touches the second lateral saddle. I therefore prefer to consider these two elements as lateral, not as auxiliary ones.

Locality: number of specimens examined.—Muth (Spiti) 6, coll. Hayden; ridge between Dharma and Lissar valleys 1, coll. La Touche.

Remarks.—From an examination of the sutural lines of Alpine and Indian examples of *Acrochordiceras* with those of *A. Damesi* I have come to the conclusion that they are not identifiable with Noetling's species. The name *Acrochordiceras Carolinæ* must therefore be retained for the Alpine species. In *A. Carolinæ* the majority of Indian specimens here described might be included. It appears, however, doubtful, whether the example from the Bosnian Muschelkalk of Han Bulog illustrated by F. v. Hauer, also belongs to *A. Carolinæ.* The larger number of umbilical tubercles and of dichotomous ribs and some differences in the character of the sutures would necessitate a rather wide range of circumscription of this species, if F. v. Hauer's type were to be included. There is, however, another species from the Alpine Muschelkalk, which, according to my opinion, must be identified with *A. Carolinæ.* This is *A. undatum* Arthaber, from the Muschelkalk of Grossreifling.

Badly preserved fragments have led the author to a misinterpretation of this species, which was at first compared with *A. pustericum.* Complete specimens, which have been discovered later on, do not exhibit any difference from *Acrochordiceras Carolinæ.*

From the upper Ceratite limestone of the Salt Range a fragment has been referred to *Acrochordiceras Damesi* by Waagen (Ceratite Formation, Palæontologia Indica, ser. XIII, Vol. II, p. 97, Pl. IV, fig. 5). The correctness of this determination is open to grave objections. To me the presence of the genus *Acrochordiceras* in the Triassic deposits of the Salt Range appears very doubtful. There is some probability of the fragments attributed to this genus by Waagen, belonging to *Keyserlingites.* They exhibit a remarkable similarity to inner volutions of *K. Dieneri* Mojs., but it is, of course, impossible to decide with certainty the generic position of fragments so poorly preserved.

2. Acrochordiceras Balarama Diener.

1895. *Acrochordiceras Balarama* Diener, Himálayan Fossils, Palæont. Indica, ser. XI, Vol. II, pt. 2. The Cephalopoda of the Muschelkalk, p. 35, Pl. VII, fig. 3.

A. v. Krafft (General Report, Geol. Survey of India, 1898-99, p. 19) believed *Acrochordiceras Balarama* to be an extraordinarily stout variety of *A. Damesi.* I deem it preferable to retain it as a proper species. There are differences in shape and sculpture sufficiently well marked to justify a specific separation of *A. Balarama* and *A. cf. Carolinæ.*

In *A. Balarama*, the transverse section of the inner volutions is nearly circular. The umbilical margin is less distinctly defined. Umbilical tubercles are developed at a later stage of growth and are less prominent. The ribs are more numerous and less stout. The whorls overlap one another only very slightly.

Of this species examples of small size only are known to me. The largest fragment of a body-chamber volution has a height of 16 mm. corresponding to a thickness of 22 mm. A similar proportion of height and thickness has not been noticed in any specimen of *A. Carolinæ.*

Sutures.—Agreeing exactly with those of the preceding species.

Locality: Number of specimens examined.—Muth (Spiti) 2, coll. Hayden, 1, coll. Krafft; ridge between Dharma and Lissar valleys 1, coll. La Touche.

3. Acrochordiceras sp. ind. aff. pusterico Mojs.

Two fragmentary specimens belong to all appearance to a species of the group of *Acrochordiceras pustericum* v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst. X, p. 143, Taf. VI, fig. 4), which is distinguished by the complete absence of umbilical tubercles. One of those specimens, although attaining a diameter of 60 mm., is not only devoid of umbilical tubercles, but its ornamentation is even less developed in the vicinity of the umbilical edge, than in the marginal region of the lateral parts. The external resemblance of this specimen to some representatives of the upper Triassic genus *Jovites* is rather remarkable.

The two specimens are, unfortunately, not suitable for illustration.

Locality: number of specimens examined.—Ridge between Dharma and Lissar valleys (Johar) 1, coll. La Touche; Kágá (Spiti) 1, coll. A. v. Krafft.

C. Pinacoceratitoidea.

Genus: Sageceras, Mojsisovics.

Sageceras, nov. sp. ind.

A cast, 31 mm. in diameter, chambered nearly up to the anterior broken edge, and somewhat distorted by pressure, is comparable by its shape to

Sageceras Walteri, v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst. X, p. 187, Taf. LIII, figs. 9, 11-13). The umbilicus, however, is smaller and early closed. The siphonal area is narrow, depressed in the middle, and separated from the lateral parts by sharp marginal keels.

The sutures are not entirely known to me. I have not succeeded in developing the lobes, but the arrangement of the numerous, elongated saddles with entire, rounded tops agrees with that in *S. Walteri*.

The specimen, from the Muschelkalk of Jolinka, Byans (coll. Smith), is so poorly preserved that its illustration may be omitted. It represents a species, which is certainly not identical with any of the Alpine forms hitherto described.

Genus: NORITES, Mojsisovics.

Sub-gen.: *ANANORITES* nov. sub-gen.

ANANORITES MONTICOLA nov. sp. Pl. XII, fig. 5.

It is with some reserve, that I attribute this species to a new sub-genus allied to *Norites* E. v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst. X, p. 201). Both its external shape and the character of its sutural line justify its being placed among the family of *Noritidæ*. But the special development of the siphonal lobe and of the auxiliary series constitute a feature of distinction between this Himálayan species and the Alpine representatives of the genus *Norites*, which to me appears to be of sub-generic importance.

The single fragmentary specimen from the upper Muschelkalk of the Bambanag cliff (coll. Krafft) is entirely chambered. Notwithstanding its fragmentary condition it is sufficiently well preserved to allow a fairly good re-construction of the entire shell.

The external shape is that of a moderately involute *Meekoceras* with a biangular siphonal part. The slowly increasing whorls are considerably higher than broad, and overlapping one another to less than one-half their height.

The diameter of the umbilicus is equal to the height of the last volution. This proportion is not met with in any of the Alpine species of *Norites*, all of which are provided with narrow umbilici.

The lateral parts are very flatly arched. Sharp marginal edges are developed at later stages of growth than in *Norites gondola* Mojs. The penultimate whorl attaining a height of 6 mm. near its commencement, has a lenticular cross-section, with a rounded siphonal part, which passes gradually into the lateral parts. Even in the last volution, where the flanks are marked off from the siphonal area by distinct marginal edges, the siphonal part itself is regularly rounded, not flattened, as is *N. gondola*

Shelly substance and cast are almost entirely smooth. The surface is covered with very delicate radiating lines of growth.

Dimensions.

Diameter of the shell	55	mm.
„ „ „ umbilicus	20	„
Height of the last volution above the umbilical suture	20	„
Height of the last volution „ „ preceding whorl	15·5	„
Thickness of the last volution	7	„

Sutures.—A sutural element of the greatest systematic value in *Norites* is the principal lateral lobe. As has been remarked by E. v. Mojsisovics, the principal lateral lobe in *Norites* and *Pronorites* is divided into two branches by a median indentation rising from the base of the lobe. In the sutural line of my specimen this median indentation is as distinctly developed as in *Norites gondola* Mojs. The perfect agreement of this lobe in the European and Himálayan species induces me to place the latter in the genus *Norites*. The strongest feature in the sutural line of the present species is the remarkable development of the siphonal lobe. In *Norites gondola* v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 202, Taf. LII, figs. 5–8) this lobe is very short and narrow and divided by a median prominence into two branches, each of them terminating in a single sharp point. The same character has been noticed by G. v. Arthaber in the species of *Norites* from the Muschelkalk of Grossreifling, described by him as *Norites apioides*, *N. psilodiscus* and *N. arcuatus*. In *N. falcatus* the siphonal lobe is as deep as the principal lateral one, but also narrow and provided with single-pointed branches. In *N. monticola* the siphonal lobe does not reach down as far as the two lateral lobes but is more than twice as broad. It is strongly serrated at its base and provided with distinct denticulations, especially so in the vicinity of the median prominence. The second and principal lateral lobes stand on an equal level. The second lateral saddle is followed by a very broad umbilical lobe, with many auxiliary indentations. A rudimentary saddle is divided by the umbilical suture.

There is no European species of *Norites* which can be compared to the present one with regard to the development of its sutural line. A species, which has been described as *N. subcarinatus* by F. v. Hauer (Die Cephalopoden des bosnischen Muschelkalkes von Han Bulog bei Sarajevo, Denkschr. Kais. Akad. d. Wiss., Bd. LIV, p. 31, Taf. VII, fig. 7), which has also a broad serrated siphonal lobe and two auxiliary lobes, probably belongs to *Hungarites* rather than to *Norites*, as has been remarked by G. v. Arthaber (Beitræge zur Palæont. und Geol. Oesterr. Ungarns, etc., X., p. 91).

With *Paranorites* Waagen from the Ceratite Sandstone of the Salt Range (Salt Range Foss. Palæont. Indica, ser. XIII, Vol. II, Ceratite Formation p. 157) our species agrees in the presence of a broad siphonal lobe and in the development of the auxiliary series. But the character of the median prominence and adjoining digitations in the siphonal lobe of *Paranorites* is entirely different. Nor has the principal lateral lobe of *Paranorites* the median indentation characteristic of the family of *Noritidæ*.

Genus : MONOPHYLLITES v. Mojsisovics.

A. Group of *Monophyllites sphærophyllus* Hauer.

1. MONOPHYLLITES SPHÆROPHYLLUS Hauer. Pl. XIII, fig. 11.

1860. *Ammonites sphærophyllus* F. v. Hauer, Denkschr. Kais. Akad. d. Wissensch., p. 113, Taf. XVIII, fig. 11.
1869. *Phylloceras sphærophyllum* E. v. Mojsisovics, Jahrb. K. K. Geol. Reichsanst., p. 586, Taf. XVI, fig. 2.
1882. *Monophyllites sphærophyllus* E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 206, Taf. LXXIX, fig. 1-3.
1888. *M. sphærophyllus* F. v. Hauer, Denkschr. Kais. Akad. d. Wiss., Bd. LIV., p. 33.
1892. *M. sphærophyllus* F. v. Hauer, ibid., Bd. LIX., p. 280.
1900. *M. sphærophyllus* Diener, Die triadische Cephalopodenfauna der Schiechlinghoehe, Beiträge zur Palæont. und Geol. Oesterr.-Ungarns etc. XIII, p. 21.
1904. *M. sphærophyllus* Martelli, Cefalopodi triasici di Boljevici presso Vir nel Montenegro, Palæont. Italica, X, p. 99, Tav. VIII, fig. 8, IX, fig. 6.

A few specimens from the upper Muschelkalk of Kágá, Spiti (coll. Krafft), are identical with this common species of the European Muschelkalk. In their general shape and involution they agree exactly with the example figured on Pl. LXXIX, fig. 3, by E. v. Mojsisovics, but are of somewhat smaller dimensions. The diameter of the largest specimen is about 70 mm. All the specimens are injured by weathering and exhibit but few traces of their shelly substance. Their most conspicuous character is the sutural line, which agrees exactly with that of *Monophyllites sphærophyllus*, but differs from the sutures of all Indian representatives of the genus by the presence of three lateral saddles.

Locality : number of specimens examined.—Upper Muschelkalk, Kágá (Spiti) 3, coll. Krafft.

2. MONOPHYLLITES KINGI Diener. Pl. XIII, fig. 5.

1895. *Monophyllites Kingi* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 109, Pl. XXXI, fig. 10.

A species of *Monophyllites* from the Triassic limestone crag of Chitichun No. I, distinguished from *M. sphærophyllus* v. Hauer by the presence of two lateral saddles only, was described by me in 1895 as *M. Kingi*. With this species a small number of examples from A. v. Krafft's Himálayan collection from the ower Muschelkalk of Spiti and Kumaon can be identified.

The largest specimen, which has been taken for illustration, is considerably larger than my type-specimen from Chitichun No. I, with which, however, it agrees in its obliquely elliptical outlines and in the shape of its transverse section. Its siphonal part is more highly rounded than in *M. Hara* Diener, and is not marked off from the lateral parts by any distinct siphonal margin. The whorls are high-mouthed and strongly compressed.

The shelly substance having been perfectly preserved in this specimen, both the numerous, faintly marked, radial folds and the delicate transverse striæ of growth are very clearly exhibited. The transverse striæ are directed radially and cross the siphonal area without being turned forward, as in *M. sphærophyllus.*

In a second specimen the radial plications are a little more sharply marked and constitute an element of ornamentation considerably exceeding in strength the transverse striæ of growth.

A third specimen is a transitional form between ***Monophyllites Kingi*** and ***M. Hara***, having less strongly compressed whorls and a more broadly rounded siphonal area.

Dimensions (of the figured specimen).

Diameter of the shell	97	mm.
Height of the outer whorl	36	„
Thickness „ „ „	28	„
Diameter of the umbilicus	35	„
Height of the whorl } in the place of its	25	„
Thickness „ „ } greatest applanation	22	„
Corresponding height of the shell	70	„
„ „ „ „ umbilicus	29	„

The measurements of this specimen, corresponding to the diameter of my type-specimen from Chitichun No. I, are as follows:—

		Type-specimen.
Diameter of the shell	59 mm.	57 mm.
„ „ „ umbilicus	23 „	22 „
Height of the outer whorl	22 „	21 „
Thickness „ „ „	16 „	12 „

Sutures.—In consequence of the larger size of my specimens their sutural lines do not agree with those of my type-specimen from Chitichun No. I in every detail. All essential features are, however, identical. There are only two lateral saddles present. The principal lateral saddle is considerably larger than the short and club-shaped siphonal one.

The lateral lobes are tricuspidate. The umbilical lobe is provided with a small number of secondary indentations.

Locality: number of specimens examined.—Lower Muschelkalk, W. of Lilang, 2, coll. Krafft; Bambanag cliff 1, coll. Krafft.

3. MONOPHYLLITES HARA Diener. Pl. XIII, figs. 6, 7. *var.* Pl. XIII, fig. 8.

1895. *Monophyllites Hara* Diener, Palæont. Indica, ser. XV, Himálayan Foss., Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 108, Pl. XXXI, fig. 9.

From the lower Muschelkalk of Lilang and of the Bambanag cliff several specimens of ***Monophyllites*** have been collected by A. v. Krafft, agreeing in all essential points with ***M. Hara*** from the Triassic limestone-crag of Chitichun No. I, so that a description of them may here be omitted.

A specimen from the Shalshal cliff (beds with *Spiriferina Stracheyi*) is distinguished from the typical form by its very high and compressed transverse section and by its more strongly marked radial ornamentation. I regard this specimen as a variety of *Monophyllites Hara.*

Sutures.—Agreeing in every respect with those of the type-specimen of *M. Hara*, as may be seen from the illustration in fig. 7.

Locality: number of specimens examined.—Lower Muschelkalk, west of Lilang, 3, coll. Krafft; Bambanag cliff 2, coll. Krafft; Shalshal cliff 1, coll. Krafft.

Remarks.—The group of *Monophyllites Hara* and *M. Kingi*, distinguished from *M. sphærophyllus* by the smaller number of lateral elements in its sutural line, is rather widely spread in the Muschelkalk of the Tethys. In the Triassic limestone of Ismid (Asia Minor) it is represented by two species, which are, unfortunately, imperfectly known, *Monophyllites Kieperti* Toula, and *M. anatolicus* Toula (Beitræge zur Palæont. und Geol. Oesterreich-Ungarns etc. X, p. 170, Taf. XX, figs. 5, 6). Another representative of the group is *Monophyllites sichoticus* Diener (Mém. Comité Geol. de la Russie, St. Petersbourg, T. XIV. No. 3, p. 29, Taf. V, fig. 1) from the Muschelkalk of the Russian Island near Wladiwostok (Ussuri district). This species has been elevated to the rank of the prototype of a proper genus, *Ussurites*, by Hyatt (Zittel's text-book of Palæontology, English edition, p. 566), and was even removed entirely from the family of *Megaphyllitidæ*. With this view I cannot agree, taking into consideration the strong resemblance of *Monophyllites sichoticus, M. Hara* and *M. sphærophyllus* in their shape, involution, sculpture and sutural lines. This resemblance is so great, that even a specific distinction can only be based on rather subordinate characters.

Ussurites*

B. Group of *Monophyllites Suessii* Mojs.

4. MONOPHYLLITES CF. PRADYUMNA Dien. Pl. XII, fig. 9.

1895. *Monophyllites Pradyumna* Diener, Palæontologia Indica, ser. XV, Himálayan Foss., Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 106, Pl. XXXI, figs. 3, 4.

This is a fragment very similar to the type-specimen of *Monophyllites Pradyumna* from the Triassic limestone crag of Chitichun No. 1, illustrated in fig. 4, Pl. XXXI of my above-quoted memoir. Two indistinct fimbriæ are noticed in the last volution. The transverse section is of nearly circular shape and of equal height and width.

I have not succeeded in developing the sutural line.

Locality: number of specimens examined.—Lower Muschelkalk, west of Lilang, 1, coll. Krafft.

Diener has since named the group of M. Confucii Leiophyllites Diener, subgenus.

5. MONOPHYLLITES CONFUCII Diener. Pl. XIII, fig. 10.

1895. *Monophyllites Confucii* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 107, Pl. XXX, fig. 7, XXXI. figs. 1, 2.

A well preserved specimen of *Monophyllites* of large size and with a smooth shell from the lower Muschelkalk of Lilang belongs to this species, one of the

* "Ussurites" is merely a synonym for Monophyllites; but the group of M. Kingi should have a subgeneric title, "Eophyllites", for it is simple, transitional from Xenodiscus and characterizes the beds at top of Lower Trias, = what Diener calls base of Lower Muschelkalk in ~~[illegible]~~ reality the Columbites or Olenek horizon.

commonest and most characteristic species of the Triassic limestone crag of Chitichun No. I. It has nine volutions besides the embryonic cell, corresponding to a diameter of 55 mm. One-quarter of the last volution belongs to the body-chamber.

My example agrees with the type-specimen of *M. Confucii* in its shape, involution, and sculpture, and also in all details of the sutural line.

Genus : STURIA v. Mojsisovics.

STURIA SANSOVINII v. Mojsisovics.

1882. ***Sturia Sansovinii*** **E. v. Mojsisovics, Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst. X., p. 241, Taf. XLIX, figs. 5-7, Taf. L, fig. 1.**
1887. ***Sturia Sansovinii*****, F. v. Hauer, Denkschr. Kais. Akad. d. Wissensch. LIV, p. 46.**
1892. ***Sturia Sansovinii*****. F. v. Hauer. Ibidem, LIX, p. 283, Taf. X, fig. 7.**
1895. ***Sturia Sansovinii*****, Diener, Himál. Foss. Palæont. Indica. ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 61. Pl. XV.**
1896. ***Sturia Sansovinii*** **G. v. Arthaber, Die Cephalopodenfauna der Reiflinger Kalke, Beitræge zur Palæont. und Geol. Oesterr. Ungarns etc. X, p. 236.**
1900. ***Sturia Sansovinii*** **Diener. Die Cephalopodenfauna der Schiechlinghoehe, Beitræge zur Palæont. und Geol. Oesterr. Ungarns etc. XIII, p. 23.**
1900. ***Sturia Sansovinii*** **Tornquist, Zeitschr. Deutsch. Geol. Ges., 52 Bd., p. 138.**

Two fragmentary but tolerably well preserved examples of this species were collected by Hayden in the upper Muschelkalk of Kágá, Spiti, one of which is nearly equal in size to the example from the Himálayan Muschelkalk of the Shalshal cliff.

I do not hesitate to identify the Indian and Alpine forms, notwithstanding slight differences in the shape of the spiral lines near the siphonal margin, which have been noticed by G. v. Arthaber.

The stratigraphical value of *Sturia Sansovinii* as one of the most widely distributed species of ammonites in the Muschelkalk of the Tethys has been considerably reduced by the discovery of two species of *Sturia* very nearly allied to the present one in julic deposits of the Salzkammergut by E. v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI—1, Supplement, p. 307). Their specific distinction from *Sturia Sansovinii* is based on only very subordinate characters, which are barely accessible to observation in incomplete specimens.

Genus: GYMNITES v. Mojsisovics.

In accordance with E. v. Mojsisovics, Steinmann and Zittel, the name *Gymnites* is retained here as generic designation for the group of *Ammonites incultus* Beyrich, Hyatt's attempt to introduce the name *Aegoceras* Waagen for this group being opposed to the rules of palæontological nomenclature.

1. GYMNITES JOLLYANUS Oppel.

1863. *Ammonites Jollyanus* Oppel, Palæontologische Mitthellungen aus dem Museum des Bayrischen Staates I, p 271, Pl. LXXV, fig. 4.
1895. *Gymnites Jollyanus*, Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 51, Pl. X, fig. 7, XI. fig. 1, XII, fig. 1.

Of this characteristic species of the Himálayan Muschelkalk specimens have been met with in the materials collected by Hayden, La Touche and F.H . Smith from the following localities: Kágá (Spiti) 6, ridge between Lissar and Dharma valleys 1, Jolinka (Byans) 1.

2. GYMNITES VASANTASENA Diener.

1895. *Gymnites Vasantasena* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 52, Pl. XIII, fig. 2.

Two fragmentary specimens of *Gymnites* with strongly compressed whorls differ from *G. Jollyanus* by very faintly developed radial ribs, which are confined to the vicinity of the umbilical margin in the last volution, and by the arrangement of the sutural line. The principal lateral lobe is divided into two basal branches, whereas in *G. Jollyanus* it ends in a single terminal digitation. The outer branch of the siphonal saddle is not very strongly developed. In all these characters my specimens agree with *G. Vasantasena.*

Locality : number of specimens examined.—Upper Muschelkalk, Bambanag cliff, 1 mile west of Martoli encamping-ground, 2, coll. Krafft.

3. GYMNITES INCULTUS Beyrich. Pl. XIV, figs. 1, 2.

1865. *Ammonites incultus* Beyrich, Monatsber. Kgl. Akad. d. Wiss., Berlin, p. 669.
1867. *Ammonites incultus* Beyrich, Ueber einige Cephalopoden aus dem Muschelkalk der Alpen und ueber verwandte Arten, Abhandl. Kgl. preuss. Akad. d. Wiss., Berlin, 1866, p. 132, Taf. III, fig. 1.
1882. *Gymnites incultus* E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 233, Taf. LIV, figs. 1-3.
1888. *G. incultus* F. v. Hauer, Cephalopoden des Bosnischen Muschelkalkes von Han Bulog, Denkschr. Kais. Akad. d. Wiss., Wien, LIV, p. 34.
1900. *G. incultus* Diener, Cephalopodenfauna der Schiechlinghoehe bei Hallstatt, Beitræge zur Palæontologie u. Geol. Osteir.-Ungarns, etc. XIII, p. 22.
1904. *G. incultus* Martelli, Cefalopodi triasici di Boljevici presso Vir nel Montenegro, Palæont. Italica, Vol. X, p. 104, Tav. V, figs. 9, 10.
1905. *G. incultus* Airaghi, Ammoniti triasici del Monte Rite in Cadore, Boll. Soc. Geol. Ital., Vol. XXIV, p. 254.

Among the numerous specimens of *Gymnites* collected in the Muschelkalk of Spiti by Hayden and A. v. Krafft, two can be picked out, which agree exactly with descriptions and illustrations of *Gymnites incultus*, as given by Beyrich and E. v. Mojsisovics.

Both specimens consist of air-chambers only. One of them is of moderate size, attaining exactly the dimensions of Beyrich's type-specimen from Reutte. The whorls are strongly compressed and bordered by flattened lateral parts. The greatest transverse diameter corresponds with the middle of the flanks. The siphonal part is highly rounded.

The second specimen is a fragment of large size, reaching a diameter of 200 mm. Its inner volutions are not entirely preserved. It agrees with the smaller example in the character of its involution, but its largest transverse diameter is situated a little below the middle of the sides. The umbilical margin is rounded, as in the former specimen, but the umbilical wall slopes more steeply towards the umbilical suture. No radiating ribs have been noticed in the last volution.

I have given an illustration of the complicated sutures of this species. Its agreement with the illustration given by E. v. Mojsisovics is very remarkable. I cannot see any reason for separating this specimen from the European representatives of *Gymnites incultus*.

Dimensions.

		Pl. XIV, fig. 1.	Pl. XIV, fig. 2.
Diameter of the shell		92 mm.	202 mm.
„ „ „ umbilicus		35 „	82 „
Height of the last volution	above the umbilical suture	33 „	70 „
	„ „ preceding whorl	24 „	55 „
Thickness of the last volution		15 „	38 „

Locality: number of specimens examined.—North-west of Muth, Spiti, 2, coll. Hayden.

4. GYMNITES cf. HUMBOLDTI Mojsisovics. Pl. XIV, fig. 3.

1882. *Gymnites Humboldti* E. v. Mojsisovics, Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 235, Taf. LV, figs. 1–3.

1888. *G. Humboldti* F. v. Hauer, Die Cephalopoden des Bosnischen Muschelkalkes von Han Bulog, Denkschr. Kais. Akad. d. Wissensch., LIV, p. 36.

1900. *G. Humboldti* Diener, Die Cephalopodenfauna der Schiechlinghoehe bei Hallstatt, Beitræge zur Palæont. u. Geol. Oesterreich-Ungarns, etc., XIII, p. 23.

1904. *G. Humboldti* Martelli, Cefalopodi triasici di Boljevici presso Vir nel Montenegro, Palæontogr. Italica, X, p. 105.

The specific differences between *Gymnites incultus* Beyrich, *G. Palmai* Mojs. and *G. Humboldti* Mojs. are very subordinate, as has been remarked by F. v. Hauer (l. c., p. 34). According to the diagnosis given by E. v. Mojsisovics, *G. Humboldti* is distinguished from the other two species by a smaller umbilicus and by higher volutions. But the second character is not exhibited very clearly even in E. v. Mojsisovics' own type-specimens. My personal examination of rich materials from the Schiechlinghoehe and from the Bosnian Muschelkalk of Han Bulog has convinced me that neither of the two features of distinction enunciated by E. v. Mojsisovics is very prominent, and that the three forms are most intimately linked together by transitional shapes.

Among the representatives of the genus *Gymnites* in the Himálayan collection there is one example from the Muschelkalk of Muth, Spiti (coll. Hayden), which in its external shape and involution seems to agree nearly as well with *Gymnites*

Humboldti as with *G. incultus* or *G. Palmai*. Although poorly preserved, it is possible to estimate its original dimensions, which were as follows :—

Diameter of the shell	cca.	200 mm.
„ „ „ umbilicus	cca.	85 „
Height of the last volution		61 „
Thickness „ „ „		49 „

In the width of its umbilicus this specimen represents a transitional form between the three species quoted above. In the proportion of height and thickness of its last volution it stands nearer *Gymnites Palmai* than *G. Humboldti*. If, nevertheless, I refer it provisionally to the latter species, it is on account of its sutural line, which agrees very closely with that of the type-specimen of *G. Humboldti*, from the Muschelkalk of the Schreyer Alpe. It is especially the character of the second lateral lobe in which its sutures differ from those of *G. Palmai*. In *G. Palmai* this lobe is divided into two branches by a central indentation rising from its base, whereas in *G. Humboldti* it terminates in a long median point. In *G. incultus*, the branches of the siphonal saddle are broader and provided with more richly developed ramifications.

5. GYMNITES MANDIVA nov. sp. Pl. XV, fig. 1.

This species is nearly allied to *Gymnites incultus* Beyrich, from which it differs, however, by the shape of its cross-section and by its less richly serrated sutures.

In its volutions my type-specimen agrees almost exactly with the large example of *G. incultus*, from the Muschelkalk of the Schreyer Alpe, illustrated by E. v. Mojsisovics on Pl. LIV, fig. 1 of "Cephalopoden der Mediterranen Triasprovinz." But the character of its transverse section is remarkably different. The whorls are very high and strongly compressed. The siphonal part is narrow, rounded above, and bordered for a short distance by sides which are nearly parallel. The divergence of the lateral parts does not commence at the siphonal margins, as in *G. incultus* or *G. Humboldti*, but the siphonal region takes the form of a narrow crest elevated above the general contour of the shell.

This shape of the cross-section is restricted to the chambered portion of the shell. In the body-chamber, to which one-third of the last volution belongs, a complete change of outline and of sculpture takes place. The cross-section becomes square, with a broad and flattened siphonal area, separated sharply from the lateral parts which it meets in a right angle. The smooth sides are covered with strong, sharp ribs rising into obtuse tubercles in the vicinity of the marginal region. At the same time the volution becomes lower, but broadens out considerably.

Dimensions.

	Aperture.	Last air-chamber.
Diamteer of the shell	166 mm.	142 mm.
„ „ „ umbilicus	66 „	53 „
Height of the last volution above the umbilical suture	48 „	47 „
„ „ „ preceding whorl	38·5 „	... „
Thickness of the last volution	33 „	21 „

Sutures—Similar to those of *G. incultus*, but simpler. The branches of the saddles are without secondary indentations. Principal lateral lobe developed asymmetrically.

Locality : number of specimens examined.—Muth (Spiti) 1, coll. Hayden.

6. GYMNITES KIRATA Diener.

1895. *Gymnites Kirata* Diener, Himál. Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 53, Pl. X, figs. 2, 3.

The group of *Gymnites* with elliptical outlines, to which the name *Ammonites Batteni* was provisionally assigned by Strachey (Palæontology of Niti, Pl. XI, fig. 2), is very richly represented in the Himálayan collection. In my memoir on the Cephalopoda of the Himálayan Muschelkalk I have advocated the separation of three species among this group, *Gymnites Kirata*, *G. Sankara*, and a third, unnamed species, which is distinguished from the latter by the development of lateral ribs.

Gymnites Kirata agrees with Stoliczka's variety of *Ammonites Batteni* with low but thick whorls. It is represented by three specimens in Smith's collection from the Muschelkalk of Jolinka (Byans). Two examples of smaller size than the type-specimen from Lilang have strongly inflated whorls of nearly equal height and thickness. The third specimen is of very large size, attaining a diameter of 135 mm., and is provided with its body-chamber. Its last volution is strongly compressed, whereas its inner whorls are as strongly inflated as in the two former examples.

In all my specimens the umbilicus is very wide and the number of whorls exposed within it is very large. No transitional shapes between this species and *Gymnites Sankara* with high and strongly involute whorls have as yet been noticed.

Locality : number of specimens examined.—Jolinka (Byans) 3, coll. Smith; north-north-west of Kágá (Spiti) 1, coll. Krafft.

7. GYMNITES SANKARA Diener. Pl. XV, fig. 4.

1895. *Gymnites Sankara* Diener, Himálayan Foss., Palæont. Indica. ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 56, Pl. XI, fig. 2.

In *Gymnites Sankara* the high, compressed forms of *Ammonites Batteni* Strachey, with strongly involute whorls, have been included. Notwithstanding the large number of specimens known to me, the variability of the species is almost insignificant. There is no considerable difference between single individuals either in the involution or in the inflation of their shells. This is exactly the opposite of what has been noticed in European representatives of *Gymnites*. With rich materials of this genus from the Muschelkalk of the Schreyer Alpe, Schiechling-hoehe or Han Bulog at hand, one is at a loss to make a clear distinction between *G. Palmai*, *G. incultus*, *G. Humboldti*, etc., which are connected by so many transitional shapes. Transitional forms of similar kind connecting *G. Sankara* with other species of Indian *Gymnites* with elliptical outlines are not known to me. It is almost invariably the same proportion of height and thickness and the same rate of involution which characterise all specimens and make them look one exactly like the other. I have not met with a single case in which a distinction of the species had to be made in a rather arbitrary manner, as has often to be done when determining European examples of *Gymnites*.

All my specimens agree closely with the type from the Muschelkalk of Lilang. In the collections examined examples of every size are represented. The largest individual with a diameter of 190 mm., exceeding considerably the dimensions of the type, is provided with a part of its body-chamber. An example of medium size has been figured in order to show that the proportions are not subject to variation from the adolescent stage of growth to old age. The dimensions of this specimen are as follows :—

Greatest diameter of the shell	73	mm.
" " " " umbilicus	28	"
Maximum height of the last volution	27	"
" thickness " " "	9·5	"

Locality : number of specimens examined.—Jolinka (Byans) 28, coll. Smith ; ridge between Dharma and Lissar valleys 1, coll. La Touche ; Kágá (Spiti) 1, coll. Hayden.

Remarks.—There is no Alpine species of *Gymnites* with elliptical outlines known to me, in which the whorls are as strongly compressed as in *G. Sankara*.

8. GYMNITES sp. ind. ex aff. SANKARA Dien.

1895. *Gymnites sp. ind. ex. aff. G. Sankara* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 57, Pl. XIII, fig. 1.

A small number of fragments from the lower Muschelkalk of Lilang and of the Gyundi river (coll. Krafft) is probably referable to this species, which differs from *G. Sankara* by a thicker transverse section and by the development of lateral ribs in the lower portion of the flanks.

Besides this species, some representatives of the genus *Gymnites* with normally encoiled whorls have been noticed among A. v. Krafft's collections from the lower Muschelkalk of Lilang. Some of them are provided with lateral ribs. The majority have smooth shells. They are too fragmentarily preserved to allow of specific determination.

9. GYMNITES DEPAUPERATUS nov. sp. Pl. XIV, fig. 4.

This is an entirely chambered fragment of a *Gymnites* with a wide, open umbilicus and with high, compressed whorls, which in its external characters appears to be very similar to *G. incultus* Beyr. In the only fragment available for examination the height of the transverse section is 32 mm. and the thickness 15 mm. Along the middle of the flanks there is a very distinct spiral ridge, whose continuity is, however, interrupted repeatedly by intervening depressions.

Sutures.—The most interesting character of this species is its sutural line, which differs from the sutures of all congeneric forms hitherto known. It is in a rather low stage of development, with dolichophyllic lobes and saddles. In this respect it recalls the sutural line of ***Japonites Ugra*** Diener (Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, The Cephalopoda of the Muschelkalk, p. 112, Pl. XXX, fig. 5), which was originally mistaken for a representative of the genus ***Gymnites.*** But the present species is certainly a true ***Gymnites,*** its auxiliary series being united with the second lateral saddle into a kind of suspensive lobe, sloping obliquely downwards to the umbilical suture, whereas in ***J. Ugra*** the lateral and auxiliary elements are distinctly separated. Otherwise a distinction of the two species would prove very difficult.

Since ***Gymnites Ugra*** has been transferred to the genus ***Japonites*** by E. v. Mojsisovics, the present species must be considered as the most primitive type of ***Gymnites,*** any trace of ramification being yet absent in the saddles, which are entirely dolichophyllic.

Locality : number of specimens examined.—Lower Muschelkalk, Lilang, 1. coll. Krafft.

10. GYMNITES RELIGIOSUS nov. sp. Pl. XVI, fig. 2.

This is a new species of the group of ***Gymnites Credneri*** v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X Bd., p. 237, Taf. LIX, figs. 1-3). It differs from the Alpine species by the smaller egression of its umbilicus and by its higher volutions, which increase more rapidly. A remarkable difference consists in the arrangement of the sutural line, which is characterised by the steep slope of its auxiliary elements.

My type-specimen is of obliquely elliptical outlines and provided with a narrow umbilicus, which scarcely departs from the normal spiral in the last volution. The whorls are very high and strongly compressed, with flat, parallel sides and with a regularly rounded siphonal area. The umbilical wall is low but steep and separated from the lateral parts by an obtusely rounded-off edge.

The shell is almost entirely smooth. No spiral ridge is developed along the middle of the flanks as in *G. Credneri.*

One-third of the last volution belongs to the body-chamber.

Dimensions.

Diameter of the shell	84	mm.
„ „ „ umbilicus	16	„
Maximum height of the last whorl	42	„
„ width „ „ „ „	16·5	„
Minimum height of the last whorl	29	„
„ width „ „ „ „	14	„
Corresponding diameter of the shell	60	„
„ „ „ „ umbilicus	9	„

Sutures.—Similar to those of ***Gymnites Sankara*** Diener, but less richly ramified. Four auxiliary saddles, which are very steeply inclined.

Locality : number of specimens examined.—Upper Muschelkalk, Thabo (Spiti), 1 coll. Hayden.

11. GYMNITES sp. ind. aff. RELIGIOSO Diener. Pl. XVI, fig. 3.

A specimen of *Gymnites* from the Muschelkalk of Muth, Spiti (coll. Hayden), differs from the preceding species by its normal shape only, which is not obliquely elliptical. The egression of the umbilicus is more distinctly marked in the last volution. It is only a matter of convenience, whether or not this difference in shape be considered as a distinctive character of specific value.

12. GYMNITES sp. ind. aff. SUBCLAUSO Hauer.

A single, greatly weathered specimen of *Gymnites* from the Muschelkalk north-north-west of Kágá, Spiti (coll. Hayden), is too badly preserved to permit a satisfactory illustration. Its general shape and its very narrow umbilicus recall *Gymnites subclausus* F. v. Hauer (Denkschr. Kais. Akad. d. Wissensch., Wien LIV, p. 33, Taf. VII, fig. 5), from the Bosnian Muschelkalk of Han Bulog. The specimen is nearly as large as Hauer's type and considerably larger than the example from the Schiechlinghoche, illustrated by myself in Beitræge zur Palæontologie und Geologie Oesterreich-Ungarns etc., XIII, Taf. I, fig. 4.

The Himálayan specimen certainly belongs to a new species. Near the beginning of the last volution traces of the original sculpture have been preserved. Falciform ribs are developed along the middle of the sides, as in *Buddhaites Rama*. From that species, however, the present one is distinguished at a glance by its rounded siphonal parts.

Dimensions.

Diameter of the shell	106	mm.
" " " umbilicus	7	"
Height of the last volution { above the umbilical suture	60	"
Height of the last volution { " " preceding whorl	41	"
Thickness of the last volution	about 26	"

Sutures.—The sutures are but imperfectly known to me. Enough of them, however, has been made accessible for examination to prove that the specimen belongs to the genus *Gymnites*. The siphonal saddle was provided with a large external branch, but it is too badly weathered to decide whether or not it was distinctly individualised as in *G. subclausus*. The auxiliary series is connected most intimately with the second lateral saddle.

Sub-genus: *ANAGYMNITES* Hyatt.

Gymnites Lamarcki Oppel (Palæontologische Mittheilungen aus dem Museum des Kgl. bayrischen Staates, 1863, I, p. 274, Taf. 75, fig. 3) from the Muschelkalk of Kuling, Spiti, has been considered as the prototype of a proper sub-genus, *Anagymnites* Hyatt (Zittel's Text-book of Palæontology, English ed., Vol. I, 1900, p. 557).

Although no diagnosis of the sub-generic characters has been given by Hyatt, it is not difficult to pick them out from my description of the species (Cephalopoda of the Muschelkalk, l. c. p. 58). The stair-like umbilicus and the sharpened siphonal part, together with a poor development of ramification in the sutural line, might be considered as features of sub-generic importance. In 1895, it is true, I explicitly declined to establish a new sub-genus for this species, but since that time the tendency towards a narrow circumscription of genera and sub-genera in ammonites has advanced so far among most palæontologists, that I no longer hesitate to accept Hyatt's sub-genus. I do this the more readily since the name has been suggested by F. v. Hauer for *Gymnites acutus*, a species from the Muschelkalk of Han Bulog, which is nearly allied to *G. Lamarcki*, as has been explained in my above-quoted memoir. The remarkable affinities between *Anagymnites* and *Japonites* are also in favour of attributing a more independent systematic position to the group of *G. Lamarcki.*

In the Indian Muschelkalk *Anagymnites* Hyatt is represented by two new species besides *Gymnites Lamarcki* Oppel.

ANAGYMNITES cf. ACUTUS v. Hauer. Pl. XV, fig. 3.

1892. *Gymnites acutus* v. Hauer, Beiträge zur Kenntniss der Cephalopoden aus der Trias von Bosnien, I Neue Funde aus den Muschelkalk von Han Bulog bei Sarajevo, Denkschr. Kais. Akad. d. Wiss., LIX, p. 282, Taf. X, fig. 6, XI, fig 2.

The only specimen—from Kágá, Spiti, coll. Hayden—reminds me very strongly of the genus *Japonites* in the character of its involution and in the shape of its transverse section. Nor should I have hesitated in grouping it with *Japonites*, had not the presence of a suspensive lobe prevented me from doing so. Although very little is exposed of the sutural line, the traces of auxiliary lobes and saddles seem to agree better with the corresponding sutural elements of *Gymnites* than of *Japonites.*

My type-specimen is certainly most nearly allied to *Anagymnites acutus* Hauer from the Bosnian Muschelkalk. Its slowly-increasing whorls leave a proportionately wide and deep umbilicus. The lateral parts converge regularly towards the sharpened siphonal edge, which is partly raised into a slightly prominent keel. There is no well defined umbilical margin, but the sides slope with gradually increasing convexity to the umbilical suture from the point of their greatest distance, which is situated below the middle of their height. In the inner volutions this umbilical convexity is comparatively higher, thus imparting to the umbilicus a stair-like character.

The sides of the inner volutions are covered with flat, broad and indistinctly defined plications. In the last whorl, containing the body-chamber, very flat and narrow radial folds can only be traced in the lower portion of the lateral parts.

The imperfect state of preservation of the only specimen known to me, excludes a direct identification with F. v. Hauer's Bosnian species.

From *Anagymnites Lamarcki* Oppel this species is easily distinguished by the character of its involution, which is quite regular throughout all stages of growth, whereas in *A. Lamarcki* the rate of involution gradually increases so considerably, that the body-chamber whorl overlaps the preceding one almost completely.

Dimensions.

Diameter of the shell		54 mm.
,, ,, ,, umbilicus		20 ,,
Height of the last volution	above the umbilical suture	21 ,,
	,, ,, preceding whorl	18 ,,
Thickness of the last volution		12 ,,

Remarks.—Anagymnites acutus is a very interesting species, on account of its affinities to *Japonites*, which are probably not dependent merely on external convergence. The sutural line agrees with that of *Gymnites* in having a suspensive lobe, which slopes obliquely from the second lateral saddle to the umbilical suture. But the main saddles are only dolichophyllic, as in *Japonites*, not richly ramified, as in typical species of *Gymnites*, and the second lateral saddle is provided with a phylloid prominence at its inner margin. This prominence, which is characteristically developed in all typical species of *Japonites*, is also noticed in *Anagymnites Lamarcki*. Thus *Anagymnites* may perhaps be more nearly related to *Japonites* and to the section of *Ammonea trachyostraca* than has hitherto been supposed.

ANAGYMNITES TORRENSII nov. sp. Pl. XV, fig. 2.

This species is also nearly allied to *Anagymnites acutus* v. Hauer. It has been based on a single but well preserved specimen of large size from Kagá, Spiti, coll. Hayden.

The shell has a slightly elliptical outline and very slowly increasing volutions, which overlap one another to more than one-half of their height in adolescent stages of growth. In the body-chamber the rate of involution slightly decreases. Near its aperture the last volution slightly overlaps the penultimate one to a little less than half its height.

The contrast in the shape of the transverse sections of the outer and inner volutions is rather considerable. The inner volutions are strongly inflated and their lateral parts slope with marked convexity towards the umbilical suture. Thus the umbilicus in the adolescent stage of growth is very deep and stair-like but gradually becomes wider and flatter. In the penultimate and last whorls the flanks are very gently arched and their slope to the umbilical suture is barely curved at all. The section of the siphonal region takes the shape of an arrow-head. The flanks converge to a sharp siphonal edge, which, however, is not elevated into a proper keel.

In the inner volutions, which are exposed within the stair-like umbilicus, indistinct plications are occasionally noticed. The penultimate and last whorls are entirely smooth.

Dimensions.

Diameter of the shell (along the shorter axis of the last volution)		137	mm.
Corresponding diameter of the umbilicus		44	„
Longest diameter of the umbilicus		65	„
Height of the last volution { above the umbilical suture		67	„
„ „ preceding whorl	about	50	„
Thickness of the last volution		27	„

Sutures.—The sutural line of this species is more decidedly gymnitic than in *Anagymnites Lamarcki* or in *A. acutus.* The main saddles are deeply incised and provided with phylla of different size and shape, no longer simply dolichophyllic, as in *Japonites,* although not yet so markedly ramified as in typical forms of *Gymnites.* The phylloid prominence affecting the inner margin of the second lateral saddle, is but faintly indicated. From this saddle a considerable number of auxiliary lobes and saddles slope towards the umbilical suture, forming together a broad and richly serrated suspensive lobe. None of the main saddles exhibit the club-shaped character which is so remarkable both in *Japonites* and in *Anagymnites acutus.*

The affinity of this species to *Japonites* is only rather distant. With the exception of the sharp siphonal edge, there is no character known to me, which might exclude an identification with the genus *Gymnites* Mojs.

Sub-genus: *BUDDHAITES* Diener.

BUDDHAITES RAMA Diener.

1895. *Gymnites* (*Buddhaites*) *Rama* Diener, Cephalopoda of the Muschelkalk. Palæont. Indica, ser. XV, Himálayan Foss. Vol. II, Pt. 2, p. 59, Pl. XIII, fig. 3, Pl. XIV, figs. 1, 2.

Of this interesting species one single example only has been collected, in the Muschelkalk of Jolinka, by F. H. Smith. The developmental stages of *Buddhaites* have been studied by myself in the type-specimen from the Shalshal cliff. The gradual changes in the shape of the umbilical area and in the siphonal part, in proportion to the progressing growth of the individual, have been mentioned as characters of special sub-generic importance.

No important addition to our knowledge of the species has resulted from my examination of the new material. In 1895 complete sutures of small and medium-sized individuals were known to me, but in the sutural line of a full-grown specimen illustrated in fig. 1*b*, Pl. XIV, the external saddle and lobe had not been preserved entirely. An examination of the present example also shows, that the individualisation of the outer branch of the siphonal saddle gradually develops into the formation of a proper adventitious saddle, which, however, is not yet as clearly marked as in *Carnites* or *Pinacoceras.*

The presence of proper adventitious lobes in the sutural line of full-grown individuals points to a close relationship of the species with *Pinacoceras.* Thus

Buddhaites ought to be considered as a transitional type, connecting *Pinacoceras* and *Gymnites*.

The development of the outer branch of a main saddle into a proper adventitious saddle is of considerable interest. A comparison of the illustrations on Pl. XIV, fig. 2, and Pl. XIII, fig. 3, of my above-quoted memoir shows that the adventitious saddle of *Buddhaites Rama* is only a detached outer branch of the primary siphonal saddle, and has nothing whatever to do with the siphonal lobe or median prominence. This observation is contradictory to the results of Noetling's examination of the development of adventitious elements in *Pseudosageceras multilobatum* (Palæontographica Vol. LI, p. 258). *Buddhaites* and probably even *Carnites* an *Pinacoceras* consequently agree with *Indoceras* or *Placenticeras* in the mode of development of their adventitious elements, not with *Pseudosageceras*.

A remarkable case of convergence exists between *Buddhaites Rama* and an Indian species of *Pinacoceras*, *P. Loomisii* Diener. Full-grown examples of both species, occurring together in the Muschelkalk of Byans, can be separated only with difficulty. The very early development of adventitious saddles and the different cross-section of the inner volutions are the leading features of distinction in *Pinacoceras Loomisii*.

Full particulars will be given in the detailed description of the latter species.

Genus: PTYCHITES Mojsisovics.

In the materials collected by Griesbach and by myself in the Central Himálayas of Spiti, Painkhánda and Johár, the genus *Ptychites* played one of the most important parts, both in number of species and of individuals. It is therefore a rather astonishing fact to find the genus very poorly represented in the collections of Hayden, A. v. Krafft and Smith. No new species has been noticed and of eighteen species, described hitherto from the Himálayan Muschelkalk, only eight are represented, belonging to the groups of *rugiferi*, *megalodisci*, *opulenti*, *flexuosi* and of *Pt. Mallelianus*.

a. Group of *Ptychites rugiferi*.

1. PTYCHITES RUGIFER Oppel.

1865. *Ammonites rugifer* Oppel, Palæontologische Mitteilungen aus dem Museum dem Kgl. bayr. Staates I, p. 293, Taf. 85.

1895. *Ptychites rugifer* Diener, Cephalopoda of the Muschelkalk, Palæontologia Indica, ser. XV, Himál. Foss. Vol. II, Pt. 2, p. 64, Pl. XXII, figs. 1, 2, XXIII, figs. 1, 2, XXIV, figs. 1, 2.

Of this common species four specimens were collected by A. v. Krafft near Kágá, 1 north-west of Muth (Spiti) and 1 in the Muschelkalk of the Shalshal cliff. I have nothing to add to the description in my above-quoted memoir, based on an examination of much more extensive materials.

2. PTYCHITES cf. COGNATUS Oppel.

1865. *Ammonites cognatus* Oppel, Palæontologische Mitteil. I, p. 285, Taf. 81, fig. 3, Taf. 85, fig. 4.
1895. *Ptychites cognatus* Diener, the Cephalopoda of the Muschelkalk, l. c. p. 67, Pl. XVIII, figs. 5, 6.

Among Hayden's collections from the Muschelkalk of Kágá, Spiti, two specimens of *Ptychites* are probably referable to this species.

Although provided with part of their body-chamber, they are of small size, attaining a diameter of only 45 mm. In the narrow umbilicus, which is bordered by very steep walls, and in the great thickness of the cross-section in the umbilical region the two examples agree with Oppel's type-specimen of ***Ptychites cognatus***, but their siphonal area is less broadly rounded.

β. Group of *Ptychites megalodisci.*

3. PTYCHITES SUMITRA Diener.

1895. *Ptychites Sumitra* Diener, Himálayan Foss. Palæont. Indica, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 72, Pl. XXVI.

This species is rather richly represented in Hayden's and A. v. Krafft's collections from the Muschelkalk of Spiti. Although no specimens are known to me equal in size to the type from the Shalshal cliff, the examples from Spiti agree with them entirely in their specific characters.

As has been explained in my above-quoted memoir, the features of distinction between ***Ptychites Sumitra*** and the Alpine ***Ptychites megalodiscus*** Beyrich are rather insignificant. But as they have been noticed in all Indian examples hitherto examined and seem, consequently, to play the part of constant characters, they may fitly be regarded as features of specific value. Such characters are the rounded umbilical margin and the more massive shape of the saddles in the sutural line.

All my specimens consist of air-chambers only. The diameter of the largest example does not exceed 115 mm. in length.

Locality : number of specimens examined.—South-west of Po. (Spiti) 2, coll. Hayden; Kágá 1, coll. Hayden, 1, coll. Krafft.

4. PTYCHITES SAHADEVA Diener.

1895. *Ptychites Sahadeva* Diener, Cephalopoda of the Muschelkalk, Palæont. Indica, ser. XV, Himál. Foss. Vol. II, Pt. 2, p. 71, Pl. XXV, figs. 1, 2.

Numerous specimens of this species were known to me in 1895 from Griesbach's collections from Kalapani, Byans. A medium-sized example with elliptical outlines and strongly compressed volutions has been noticed in F. H. Smith's collections from the Muschelkalk of Jolinka.

γ. Group of *Ptychites Malletianus.*

5. Ptychites Durandii nov. nom. Pl. XIII, fig. 12.

1895. *Ptychites nov. sp. ind. ex aff. Malletianus* Diener, Cephalopoda of the Muschelkalk, l. c., p. 74, Pl. XVII, fig. 2.

Of this form, which is nearly allied to *Ptychites Malletianus* Stoliczka (Memoirs, Geol. Survey of India, Vol. V, Pt. 1. p. 58, Pl. V, fig. 1), a fragmentary example only, from the Muschelkalk of Padam, Spiti, was known to me in 1895. In Hayden's collection from Muth the species is represented by a fairly well preserved specimen, which justifies the introduction of a proper specific denomination.

I have to add but little to the description given in my above-quoted memoir. The umbilicus is very deep and stair-like, considerably deeper and narrower than in *Ptychites Malletianus.* The greatest transverse diameter of the cross-section corresponds to the obtusely rounded umbilical edge. Eighteen broad folds are counted in the entire last volution.

Dimensions.

Diameter of the shell		63	mm.
" " " umbilicus		24	"
Height of the last volutions	from the umbilical suture	20·5	"
	" " preceding whorl	16	"
Thickness of the last volution		38	"

Sutures.—Agreeing exactly with those of the type-specimen from Padam.

δ. Group of *Ptychites opulenti.*

6. Ptychites Everesti Oppel.

1863. *Ammonites Everesti* Oppel, Palæontologische Mitteil. aus dem Museum d. Kgl. bayr. Staates, I., p 284, Taf. 81. figs. 1, 2.

1895. *Ptychites Everesti* Diener, Cephalopoda of the Muschelkalk, Palæont. Indica, ser. XV, Himál. Foss. Vol. II, Pt. 2, p. 76, Pl. XIX, fig. 1, Pl. XX, figs. 1, 6.

A specimen agreeing exactly with the large type from the Shalshal cliff, illustrated on Pl. XIX of my above-quoted memoir, has been noticed in Hayden's collection from the Muschelkalk of Kágá, Spiti. It has a diameter of 150 mm. and is provided with its body-chamber. The number of folds in the last volution is eighteen. The siphonal part is sharply rounded but not acute.

Ptychites Everesti is probably represented in the Alpine Trias by a very nearly allied species, which has been described in my memoir on the Cephalopoda of the Schiechlinghoehe near Hallstatt (Beitræge zur Geol. und. Palæont. Oesterreich-Ungarns, etc., XIII, p. 32).

7. PTYCHITES cf. VIDURA Diener.

1895. *Ptychites Vidura* Diener, Palæontologia Indica, ser. XV, Himálayan Foss. Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 76, Pl. XX, figs. 2-4, 5.

This species is characterised by its remarkable sculpture, consisting of strong and straight ribs, which alternate regularly with weaker folds. It is probably represented in Hayden's collections from the Muschelkalk of Muth, Spiti, by a specimen of very small size, which, in consequence of its smaller dimensions, shows the ornamentation less distinctly developed than the full-grown types illustrated in my above-quoted memoir. Its diameter is 31 mm. in length.

ε. Group of *Ptychites flexuosi*.

8. PTYCHITES MAHENDRA Diener.

1895. *Ptychites Mahendra* Diener, Cephalopoda of the Muschelkalk, Palæont. Indica, ser. XV, Himálayan Foss., Vol. II, Pt. 2, p. 80, Pl. XVI, figs. 1, 2.

A well preserved specimen from the Muschelkalk of Muth, Spiti, coll. Hayden, differs from the very nearly allied *Ptychites flexuosus* Mojs. by the same features as have been noticed in the types illustrated in my above-quoted memoir. The only difference of importance between *Ptychites Mahendra* and *Pt. flexuosus* is the larger size of the siphonal saddle in the sutural line of the Indian species. Otherwise my Himálayan form can scarcely be distinguished from the compressed variety of the Alpine species.

Genus: PINACOCERAS v. Mojsisovics.

1. PINACOCERAS RAJAH nov. sp. Pl. XVI, fig. 1.

This new species of *Pinacoceras* occupies a rather isolated position among its congeneric forms. It recalls *Pinacoceras trochoides* Mojs. and *P. aspidoides* Diener in the phylloid development of its sutural elements. It agrees with the group of *P. Metternichii* v. Hauer in the presence of a comparatively wide umbilicus, but in all other respects its external shape is more similar to that of *P. aspidoides* Diener (Die Cephalopodenfauna der Schiechlinghoehe bei Hallstatt, Beitræge zur Geol. and Palæont. Oester.-Ungarns, etc., XIII, p. 19, Taf. I, figs. 5, 6).

The figured type-specimen is characterised by narrow and high, regularly increasing volutions, which overlap one another very considerably, and by a screw-shaped umbilicus. In the last volution the umbilical suture deviates from the normal spiral but very little. The aperture being situated a short distance in front of the last septum, the entire shell must have reached a diameter of 200 mm. at least.

At the commencement of the last volution the siphonal part is more sharply rounded than in the vicinity of the aperture. The greatest transverse diameter coincides with the middle of the lateral parts. The transverse section is not regularly elliptical but rather lanceolate, at least in the inner volutions. In the last volution a marked depression of the shell is noticed in the umbilical region of the lateral parts. The umbilical wall is vertical and separated from the flanks by a sharp edge.

The ornamentation consists of very delicate falciform ribs, which are confined to the posterior portion of the last whorl and are most distinctly marked in the vicinity of the siphonal part.

Dimensions.

Diameter of the shell	143 mm.
„ „ „ umbilicus	20 „
Height of the last volution { above the umbilical suture	70 „
Height of the last volution { „ „ preceding whorl	47 „
Thickness of the last volution	27 „

Sutures.—There are only two lateral lobes present, the projection of the periphery of the preceding whorl touching the top of the second lateral saddle in the last volution. Between the principal lateral and the deep external lobe, which stand at an equal level, three saddles are counted. The external adventitious saddle is short and simple. The two following saddles are dimeroid, with higher and more strongly developed inner branches. The two lateral lobes terminate in sharp median indentations. The second lateral saddle is dimeroid: so also are the auxiliary saddles, of which there are four. The second lateral saddle and the auxiliary series are not separated distinctly but are linked together as closely as in the genus *Gymnites*. From the top of the principal lateral saddle the sutures slope towards the umbilicus in a nearly straight line. This character is equally well developed in *P. aspidoides* and in *Buddhaites Rama* Dien.

In their general development the sutures exhibit the phylloid type of leaf-shaped denticulation of the saddles, as in *Pinacoceras aspidoides*. This species from the Alpine Muschelkalk of the Schiechlinghoehe is probably the nearest ally to our Indian form, although the characters of distinction between them are very remarkable. The difference in the width of the umbilicus alone is sufficient to forbid any closer comparison. But in the generality of characters and in the arrangement of the sutural line there are, indeed, several points of affinity. *Pinacoceras aspidoides* has, it is true, three main lobes and two adventitious saddles, but these differences are of secondary importance only. From the groups of *P. Metternichii* and *P. imperator* our species is distinguished both by the more robust development of its sutures, without complicated ramifications, and by the small number of adventitious elements.

Locality; number of specimens examined.—Kágá, Spiti, 1, coll. Hayden.

2. PINACOCERAS LOOMISII nov. sp. Pl. XVII, figs. 1, 2, 3.

There is a very remarkable case of convergence between this species and *Buddhaites Rama* Diener. In the Muschelkalk of Jolinka, Byans, a species of flat, high-mouthed *Pinacoceratinæ* with a sharp external edge and with narrow umbilici, is rather richly represented. As its sutural line acquires adventitious elements at very early stages of growth, it must be grouped with the genus *Pinacoceras* v. Mojsisovics.

It is not easy to separate full-grown examples of *Pinacoceras Loomisii* from *Buddhaites Rama.* Both species agree in their dimensions, in the character of involution, shape and sculpture. *P. Loomisii* occasionally, though not constantly, develops falciform ribs arranged along a spiral line, which gradually passes from the middle part into the upper portion of the sides. This is the same pattern of ornamentation as has been described in *Buddhaites Rama* and in *Gymnites Jollyanus* Oppel. The umbilicus is a little narrower than in *B. Rama*, but this difference is only of minor importance.

The ontogeny of our species affords some characters of distinction from *Buddhaites Rama.* The inner volutions are provided with a sharp siphonal edge at earlier stages of growth, and the umbilicus is not wide and shallow, but narrow as in old age. It only needs a comparison of the two examples illustrated in fig. 3 of the present memoir and in Pl. XIV, fig. 2 of my description of the Cephalopoda of the Himálayan Muschelkalk (Vol. II, Pt. 2) to see this remarkable difference. In the specimen of *Buddhaites Rama* the inner nucleus is provided with an umbilicus, attaining a width of 4·5 mm. and corresponding to a height of the volution of 11 mm., whereas in the example of *Pinacoceras Loomisii* the umbilicus is almost completely closed. This difference in the character of their umbilici sufficiently proves a different ontogeny in both species. Another character of ontogenic difference is the very early development of a sharpened siphonal edge in *Pinacoceras Loomisii*, whereas inner nuclei of *Buddhaites Rama* are provided with a rounded siphonal part.

Dimensions.

Diameter of the shell		102 mm.
„ „ „ umbilicus		4 „
Height of the last volution	above the umbilical suture	59 „
	„ „ preceding whorl	36 „
Thickness of the last volution		14 „

Sutures.—The sutures of this species agree almost exactly with those of large examples of *Buddhaites Rama.* A very large and bipartite adventitious saddle is present. The primary external saddle is also bipartite and more distinctly so than in *B. Rama.* But in this detail I can find the only remarkable difference between the sutures of the two species. In its ontogeny, however, *Pinacoceras Loomisii* is distinguished by the very early development of adventitious elements. In the specimen of *Buddhaites Rama* illustrated on Pl. XIV, fig. 2 of my above-quoted memoir, the outer branch of the siphonal saddle has not yet reached the character of a proper adventitious saddle corresponding to a diameter of the shell of 80 mm. In the smallest example of *P. Loomisii* (fig. 3) the individualisation of the adventitious saddle is quite distinctly developed and corresponds to a diameter of the shell of only 40 mm.

Locality: number of specimens examined.—Jolinka (Byans) 9, coll. Smith.

Remarks.—In my opinion the similarity of *Buddhaites Rama* to *Pinacoceras Loomisii* in all its important characters ought not to be considered as due to convergence but tends to prove the phylogenetic relationship of the two forms. As has been noticed by E. v. Mojsisovics, a second genus of *Pinacoceratinæ* with adventitious saddles, *viz.*, *Placites*, stands in close phylogenetic relationship to *Gymnites subclausus* v. Hauer. There is some probability of *Gymnites* being one of the roots of *Pinacoceras* and its allies.

D.—ARCESTOIDEA.

Genus: ARCESTES Suess.

Sub-genus: *PROARCESTES* Mojs.

PROARCESTES sp. ind. ex. aff. BRAMANTEI Mojs. Pl. XVI, fig. 4.

1899. *Proarcestes sp. ind. ex aff. P. Bramantei* A. v. Krafft, General Report, Geol. Survey of India, for 1898-99, p. 16.

This is an inner nucleus with thick, globose volutions, and with three faintly developed varices, appearing as shallow furrows on the cast.

In the sutures, which are only partially accessible to observation, the siphonal lobe is remarkable for its very deep position, thus excluding any identification with *Proarcestes Balfouri* Oppel.

Locality: number of specimens examined.—North-north-west of Kágá 1, coll. Hayden.

Genus: JOANNITES v. Mojsisovics.

JOANNITES cf. PROAVUS Diener. Pl. XV, fig. 5, Pl. XVII, fig. 5.

1899. *Joannites aff. diffissus* (Hauer) A. v. Krafft., General Report, Geol. Surv. of India, for 1898-99, p. 18.

1900. *Joannites proavus* Diener, Die Triadische Cephalopodenfauna der Schiechlinghoehe bei Hallstatt, Beiträge zur Geol. und Palæont. Oesterr.-Ungarns, etc., XIII, p. 13, Taf. 1, figs. 1, 2.

A. v. Krafft was perfectly right in comparing this species to *Joannites diffissus* v. Hauer (Sitzgsber. kais. Akad. d. Wiss. XLI, p. 144, Taf. IV, fig. 11-13) from the carnic stage of the Alpine Trias. It is this remarkable group of *Joannites* to which it undoubtedly belongs.

The larger specimen illustrated is the inner nucleus of an ammonite which in its dimensions and in all its external characters bore the greatest resemblance to *Joannites proavus* from the Muschelkalk of the Schiechlinghoehe. Unfortunately I have not succeeded in scaling off the last volution, without destroying it. Thus the inner nucleus with its air-chambers only remains. The most characteristic features of the group of *Joannites diffissus*, namely, the two constrictions standing exactly opposite each other, are less distinctly seen in the present nucleus than in my Alpine type of *Joannites proavus*, because one of them is situated very close to the aperture and the other coincides with a portion of the shell which has been broken off.

In the smaller specimens, however, the inner nucleus is provided with very deep constrictions. As in *Joannites diffissus*, the constrictions are most strongly developed in examples of medium size. As in my type-specimen of *J. proavus*, the constriction is followed by a distinct inflation of the shell, resulting in a considerable difference of thickness of the cross-section on either side of the constriction.

The shell is strongly globose and provided with a very narrow umbilicus. The inflation of the specimen illustrated on Pl. XVII, fig. 5, is considerably inferior to that in the larger type and also in the remaining examples. But this character being subject to a great variability in many species of *Arcestoidea*, I do not consider the difference to be of specific importance.

Dimensions.

Diameter of the shell	40	mm.
" " " umbilicus	3·5	"
Height of the last volution	21	"
Thickness " " "	33	"

Sutures.—Of the sutural line four lobes and three saddles are accessible to observation. They are arranged along a line, which is only very slightly curved forward, considerably less so than in *Joannites diffissus*. The siphonal lobe is the deepest and is divided by a high and richly serrated median prominence. The saddles exhibit a dimeroid shape, as in typical species of *Joannites*. The principal lateral lobe is divided at its base by a large indentation, giving it a bifid termination, as in *J. diffissus*, but the second lateral and first auxiliary lobes each terminate in a single median point.

Locality: number of specimens examined.—North-north-west of Kágá 4, coll. Hayden.

JOANNITES sp. ind. Pl. XIV, fig. 5.

An inner nucleus of *Joannites* from the same locality differs from the group of *J. diffissus* Hauer by the absence of any distinct constrictions or varices. The siphonal part is broadly rounded. The cast is entirely smooth and provided with a very narrow umbilicus.

The sutures exhibit a serial arrangement, with dimeroid saddles, as in typical species of *Joannites*.

There is no Alpine species of the genus known to me to which the present one might be compared.

SUMMARY.

Although only a short period has elapsed since the publication of the results of the Himálayan expedition in 1892, in which Griesbach, Middlemiss and myself took part, a great amount of new material has been obtained during the last few years. The geological survey of the sedimentary belt of the Himálayas has been resumed and large areas have been re-examined in greater detail, which formerly had been known only more or less superficially. The examination of the rich collections from the Muschelkalk obtained by Hayden, A. von Krafft, Smith and La Touche, along with their observations in the field, has led to many new and important results.

The Muschelkalk of the Shalshal cliff, the only section in the Himálayas which in 1892 was known in any detail, had been subdivided by C. L. Griesbach (Memoirs, Geological Survey of India, XXIII, p. 143), as follows :—

Bed 122. Very hard, grey, concretionary limestone in massive beds, with subordinate partings of dark shales containing many fossils . . . . 50 ft.
Bed 121. Earthy, grey limestones, shales near base, yielding in large numbers *Rhynchonella semiplecta var.* (*Rh. Griesbachi* Bittn.) and *Rhynchonella Salteriana* (*Retzia himaica* Bittn.) . . . . 3 ft.

Bed 121 was looked upon by Griesbach as a lower division and bed 122 as the main mass or upper division of the Muschelkalk (*ibid*, pp. 70-72). I accepted Griesbach's view in distinguishing a thin, lower division with *Brachiopoda* and a thick upper division with *Cephalopoda* in the Muschelkalk of the Shalshal cliff. The lower division, corresponding with bed 121 in Griesbach's section, was named "Zone of *Sibirites Prahlada*" and was said to contain the following species of *Brachiopoda*[1] :—

Rhynchonella Griesbachi Bittn.
Spirigera nov. sp.
Spiriferina Stracheyi Salt.
Retzia nov. sp.

Subsequently Bittner showed that two different faunas had been included in this list, and expressed his doubts that both should occur in the same horizon, *viz.*, in the thin bed 121, together with *Sibirites Prahlada.*[2]

Those two faunas, distinguished for the first time by Bittner in 1899, are:

1. The fauna with *Rhynchonella Griesbachi*, containing, besides this species, *Retzia himaica* and *Norella Kingi.*

2. The fauna with *Spiriferina Stracheyi*, containing the following species of *Brachiopoda* :—

Rhynchonella Dieneri Bittn.
" *mutabilis* Stol.
Spiriferina Stracheyi Salt.
Spirigera Stoliczkai Bittn.
Dielasma Himalayanum Bittn.

Diener: Ergebnisse einer geologischen Expedition in den Central-Himalaya von Johar, Hundes und Painkhanda, Denkschr. kais Akad. d. Wiss., Wien, LXII, 1895, p. 571.

[2] Jahrb. K. K. Geol. Reichsanst., 1899, p. 692.

In 1899 A. v. Krafft, while studying the sections near Lilang in Spiti, discovered a brachiopod-bearing horizon in the Muschelkalk, which yielded large numbers of the following forms:—

Spiriferina Stracheyi Salt.
Spirigera Stoliczkai Bittn.
Rhynchonella mutabilis Stol.
Dielasma Himalayanum Bittn.

But he searched in vain for *Rhynchonella Griesbachi* and consequently confirmed Bittner's doubts as to the association of the two faunas quoted above.[1]

In the following year A. v. Krafft had an opportunity of studying the Shalshal cliff and Bambanag sections in detail and was enabled to arrive at a definite conclusion on this question. He found that there were indeed two different Brachiopod-bearing horizons, *viz.*, that of *Spiriferina Stracheyi* above, and that of *Rhynchonella Griesbachi* below, a compact mass of nodular limestone very poor in fossils. As had been stated by Griesbach, he found the layer with *Rhynchonella Griesbachi*, three feet in thickness, immediately above the topmost beds of the Lower Trias (Hedenstrœmia beds, Subrobustus beds *antea*), but at the same time convinced himself, that the large *Brachiopoda*, characterising the *Spiriferina Stracheyi* beds in Spiti, were not represented in this layer. The bed with *Rhynchonella Griesbachi* he found overlaid by a nodular limestone of considerable thickness, above which he discovered a bed with the rich fauna of *Spiriferina Stracheyi*. A few inches below this narrow band of shaly limestone with *Spiriferina Stracheyi* a bed of hard, grey limestone was traced throughout Bashahr, Spiti and Kumaon, containing numerous *Cephalopoda*, among them *Ceratites subrobustus* (*Keyserlingites Dieneri* Mojs.) and several species identical with forms described by myself from the "Middlemiss crag" of the Chitichun area in Tibet.

In 1901 H. Hayden succeeded in finding the layer with *Rhynchonella Griesbachi* at the base of the nodular limestone in the sections of Spiti, in the exact position in which it had been found by A. v. Krafft in the Shalshal and Bambanag cliffs. In Spiti, however, it is poorly developed and "fossils are scarce, and it had, consequently, been previously overlooked."[2]

Thus there is an almost perfect identity in the development of the Muschelkalk sections in Spiti, Johar and Painkhanda, as will be seen from a comparison of the near Lilang in Spiti and of the Bambanag cliff in Kumaon.[3]

Lilang.	*Bambanag Cliff.*
4. Upper Muschelkalk with many Cephalopoda . . 22 ft.	Upper Muschelkalk . 20 ft.
3f. Grey limestone with *Ceratites Ravana* . . . 16 ins.	3i. Shales with concretions containing *Sp. Stracheyi* . 2 ft.

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[1] General Report, Geol. Survey of India for 1899-1900, p. 202.

[2] *H. Hayden:* The Geology of Spiti. Mem. Geol. Surv. of India, Vol. XXXVI, Pt. 1, p. 69.

[3] Left among Dr. A. v. Krafft's notes accompanying his collections.

3e. Grey concretionary limestone . . . 6 ins.	3h. Dark grey limestone with *Sp. Stracheyi*, *Spirigera Stoliczkai* . . . 1 ft.
3d. Horizon of *Spiriferina Stracheyi* . . . 4 ins.	
3c. Grey limestone . . 3 "	3g. Black shales . . 5 ins.
3b. Hard, grey limestone with the fauna of *Ceratites subrobustus* (*Keyserlingites Dieneri*) 4 ins.	3f. Dark grey limestone with *Spiriferina Stracheyi*, *Ceratites subrobustus*, *Monophyllites div. sp.* . . 5 ins.
3a. Thin layers of grey limestone and shale . . . 3 ft.	3e. Black shales . . 2 "
	3d. Limestone as 3f . 7 "
	3c. Black shales . 5 "
	3b. Limestone as 3h with *Monophyllites* sp. . 6 ins.
	Black shales with *Ceratites subrobustus* . . 6 ins.
2. Nodular limestone { Upper division: 30 ft. lower division with *Ceratites* sp., *Tirolites* sp. . . 30 ft.	2. Nodular limestone about 50 ft.
1 Bed with *Rh. Griesbachi* 3 ft.	1 Earthy limestone with *Rh. Griesbachi* . 3 ft.

At the Shalshal cliff A. v. Krafft observed the following subdivisions in the Muschelkalk, in descending order:—

4. Upper Muschelkalk very rich in *Cephalopoda*.

3b. Thin beds of limestone with the fauna *Spiriferina Stracheyi* and *Monophyllites* sp.

3a. Limestone with *Ceratites subrobustus* (*Keyserlingites Dieneri*).

2. Nodular limestone (unfossiliferous).

1. Earthy limestone with *Rhynchonella Griesbachi* and *Retzia himaica*.

The section of the Bambanag cliff clearly shows that there is no definite boundary between the beds containing brachiopods and those containing ammonites. As we pass upwards in the section from the top of the nodular limestone (2), the ammonites are gradually replaced by brachiopods. The whole series between the nodular limestone (2) and the upper Muschelkalk (4) with its rich fauna described in Vol. II, Pt. 2 of the Palæontologia Indica (ser. XV) will therefore best be united in one group (3), but it must be understood, that the *Cephalopoda* prevail in the lower part of this group and the *Brachiopoda* in the upper.[1]

Beds 3 and 4 certainly belong to the stage of the Alpine Muschelkalk (anisic stage). The age of the nodular limestone (2) and of the bed with *Rhynchonella Griesbachi* is looked upon as doubtful by Hayden and A. v. Krafft. From two horizons—one of them six inches above the top of the bed with ***Rhynchonella Griesbachi***, the other about 30 feet above it in the middle of the nodular limestone—several fragments of ammonites were found by Hayden in the Spiti sections in 1901. One of them was considered by A. v. Krafft to be a species of ***Ceratites*** identical with a form previously obtained from the Hedenstrœmia beds of Muth, the second species was identified with ***Tirolites injucundus*** Krafft (Manuscript) from the same locality. On the strength of these discoveries the boundary line between the lower Trias and the Muschelkalk is drawn by Hayden and A. v. Krafft at or above the middle of the nodular limestone (2). The horizon of ***Rhynchonella Griesbachi*** is consequently included in the lower Trias.[1]

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[1] Compiled from unpublished notes left by the late Dr. A. v. Krafft.

No description nor illustration of the two ammonites collected in the nodular limestone by Hayden having been published, the question cannot be considered as beyond dispute.

The only ammonite recorded by myself from the beds with ***Rhynchonella Griesbachi*** is ***Sibirites Prahlada***. The specimen, to which this specific name was assigned, had been chiselled out from the rocks ***in situ*** and in a section of the Shalshal cliff not locally identical with the section where the large species of the zone of ***Spiriferina Stracheyi*** had been found. In Spiti ***Sibirites Prahlada*** was collected by Hayden and A. v. Krafft in the Cephalopod-bearing horizon immediately below the layer of ***Spiriferina Stracheyi***. It is, therefore, probable that this species ranges from the beds with ***Rhynchonella Griesbachi*** into a stage of undoubted Muschelkalk age. The name "zone of ***Sibirites Prahlada***," which has been applied by myself to the beds with ***Rhynchonella Griesbachi***, must be discarded, ***Sibirites Prahlada*** being a fossil of the rarest occurrence in those beds and having its main layer in division 3 of the Muschelkalk.

I must draw the reader's attention to the fact, that by including the nodular limestone (2) in the Muschelkalk, the similarity of this group with the Alpine Muschelkalk becomes most striking. The brachiopod-bearing beds with ***Spiriferina Stracheyi*** and the underlying layer of ***Keyserlingites Dieneri*** might be compared to the ***Binodosus*** zone of the Eastern Alps, which lies proportionately high in the mass of the Alpine Muschelkalk. A representative of the thick unfossiliferous main mass of the Alpine Muschelkalk must consequently be sought for in the nodular limestone with the layer of ***Rhynchonella Griesbachi*** at its base.

In the absence of more convincing evidence I prefer, however, to leave the age of the nodular limestone and of the beds with ***Rhynchonella Griesbachi*** an open question.

Leaving aside the beds with ***Rhynchonella Griesbachi*** (group 1) and the nodular limestone (2) with its few and poorly preserved fossil contents, the Muschelkalk of Spiti, Johar and Painkhanda falls naturally into two subdivisions, (3) and (4.) To the lower subdivision the Cephalopod horizon with ***Keyserlingites Dieneri*** and the Brachiopod horizon with ***Spiriferina Stracheyi*** belong. They do not constitute two separate and distinct horizons, but, as is evident from A. v.

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[1] Hayden, Geology of Spiti, l. c. p. 67.

Krafft's researches, one stratigraphical horizon only, in the lower part of which *Cephalopoda* predominate and in the upper *Brachiopoda*.

In the present memoir the following fossils have been described from the lower subdivision (3) of the Muschelkalk of Spiti, Painkhanda and Johar:—

BRACHIOPODA.

Spiriferina Stracheyi Stol.
Spirigera Stoliczkai Bittn.
Dielasma himalayanum Bittn.
Rhynchonella mutabilis Stol.
„ *Dieneri* Bittn.

LAMELLIBRANCHIATA.

Pleurophorus sp. ind.

NAUTILOIDEA.

Orthoceras cf. multilabiatum Hauer. (Shalshal cliff.)
„ *cf. campanile* Mojs. (Bambanag and Shalshal cliffs.)

AMMONOIDEA.

Ceratites (Hollandites) Vyasa Dien. (Gyundi R.)
„ *(Florianites) cf. Kansa* Dien. (Gyundi R.)
„ *(Keyserlingites) Dieneri* Mojs. (Shalshal and Bambanag cliffs; Lilang.)
„ „ *Pahari* Dien. (Lilang.)
„ „ *Pagoda* Dien. (Po.)
„ „ *sp. aff. Bungei* Mojs. (Lilang.)
„ „ *sp. ind.* (Lilang.)
Japonites cf. Ugra Dien. (Lilang.)
Stacheites Webbianus Dien. (Lilang.)
Dalmatites Ropini Dien. (Lilang; Bambanag.)
Sibirites Prahlada Dien. (Lilang.)
Gymnites depauperatus Dien. (Lilang.)
„ *sp. ind. aff. Sankara* Dien. (Lilang; Gyundi R.)
„ *sp. ind.* (Lilang; Gyundi R.; Bambanag.)
Monophyllites Kingi Dien. (Lilang; Bambanag.)
„ *Hara* Dien. (Lilang; Bambanag; Shalshal cliff.)
„ *Confucii* Dien. (Lilang.)
„ *cf. Pradyumna* Dien. (Lilang.)

The most characteristic group of ammonites in this fauna is the group of *Ceratites subrobusti* (*Keyserlingites*).

When describing my type-specimen of *Ceratites subrobustus* (= *Keyserlingites Dieneri*) from the Shalshal cliff, I stated this specimen to have been derived from the topmost layer of the lower Trias, in which *Flemingites Rohilla* is not rare. Hayden and A. v. Krafft have obtained a considerable number of species

Ceratites Dieneri in lower Muschelkalk

of *Keyserlingites* (among them *K. Dieneri*) from the lower Muschelkalk of Spiti, Johar and Painkhanda, but not a single specimen from the lower Trias. We are therefore undoubtedly justified in claiming *Keyserlingites* as a sub-genus of lower Muschelkalk age in the Himálayas.

In the face of such convincing evidence I cannot help expressing a doubt as to my own type-specimen having been collected *in situ*. I have, most probably, been mistaken in considering the block, from which it had been chiselled out, to be *in situ*, whereas it was in reality detached from the main mass of the Muschelkalk towering above.[1]

As has been explained in my description, the Himálayan types of *Keyserlingites* are not identical with those from Siberia, their mode of development showing remarkable differences. The stratigraphical position of the Indian *Keyserlingites Dieneri* does not consequently afford any clue as to the age of the Triassic beds of Siberia containing *Keyserlingites subrobustus* and its allies.

On the other hand the examination of A. v. Krafft's materials from Lilang and from the Bambanag cliff has fully confirmed his correlation of the fauna of the lower Muschelkalk in the main belt of Triassic sediments in the Himálayas with the fauna of the "Middlemiss crag" near Chitichun in Tibet. *Florianites Kansa*, *Japonites Ugra* and four species of *Monophyllites* are identical. This evidence is of no small importance, the lower Muschelkalk age of the isolated Middlemiss crag having been decided by its fossil contents only. Thus the views expressed by A. v. Krafft as to the character of the fauna of the lower Muschelkalk in his preliminary report on the Mesozoic rocks of Spiti[2] have been proved to be almost entirely correct.

Another fact of interest is the discovery of two genera, which are hitherto in Europe known only from the lower Trias, *Stacheites* and *Dalmatites*. The species representing the latter genus has been described by A. v. Krafft as "a new type of *Hungarites*, distinguished by very indistinct marginal edges."

The overwhelming majority of the Cephalopoda described and illustrated in my memoir (Vol. II, Pt. 2) belong to the upper division of the Muschelkalk, which is a homotaxial equivalent of the zone of *Ceratites trinodosus* of the Alpine Trias. *Ceratites* (*Hollandites*) *Nalikanta*, *Hollandites Srikanta* and *Hollandites Narada*—attributed formerly to the genera *Meekoceras* and *Proptychites*—are of doubtful position, since it is uncertain, whether they belong to the upper Muschelkalk only, or range into group 3 of the lower Muschelkalk of the Bambanag section. *Lobites Oldhamianus* Stol. is also of uncertain position and perhaps an upper Triassic species, no example beyond Stoliczka's type-specimen having as yet been collected. On the other hand the occurrence of ***Isculites Hauerinus*** Stol. in the upper Muschelkalk of Spiti, a fact regarded as doubtful by E. v. Mojsisovics and myself, was definitely proved, a considerable number of specimens having been collected in the upper Muschelkalk of Spiti by Hayden.

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[1] According to a letter from A. v. Krafft the mode of preservation of the specimens yields no clue. The matrix of my type-specimen is perhaps a little darker than that of specimens from the lower Trias, but it is impossible to draw any decisive conclusion from this.

In my memoir on the Cephalopoda of the Muschelkalk a species of *Keyserlingites* has been described as *Ceratites nov. sp. aff. subrobusto* and referred to the fauna of the upper Muschelkalk. It cannot be ascertained whether this species actually belongs to the upper Muschelkalk, that is to say, to those beds, which overlie group 3 of the lower Muschelkalk, or to the horizon of *Spiriferina Stracheyi*.

[2] General Report for 1899-1900, p. 205.

[3] Ergebnisse einer Geologischen Expedition in den Central-Himalaya, etc., l. c., p. 562.

Since my researches were carried out, the fauna of the upper Muschelkalk has been largely augmented by collections brought from Spiti in 1898 and 1899 by Hayden and A. v. Krafft. The species of Cephalopoda will be found in the following list:—

Orthoceras Spitiense Dien.
Mojsvaroceras Kagæ Dien.
,, *sp. ind. aff. Kagæ.*
Thuringionautilus sp. ind.
Germanonautilus cf. salinarius Mojs.
Syringonautilus Spitiensis Stol.
Grypoceras Griesbachi Dien.
Paranautilus Bullockii Dien.
,, *sp. ind.*
Ceratites Thuilleri Oppel.
,, *trinodosus* Mojs.
,, *sp. ind. aff. Abichi* Mojs.
,, *cf. Kamadeva* Dien.
Ceratites superbiformis Dien.
,, *truncus* Oppel.
,, *Devasena* Dien.
,, *Padma* Dien.
Ceratites (Hollandites) Voiti Oppel.
,, ,, *Ravana* Dien.
,, ,, *Airavata* Dien.
,, ,, *Visvakarma* Dien.
,, ,, *Dungara* Dien.
,, ,, *Hidimba* Dien.
,, ,, *Moorei* Dien.
,, ,, *Vyasa* Dien.
,, ,, *Cecilii* Dien.
Ceratites (Salterites) Oberhummeri Dien.
,, *(Haydenites) Hatschekii* Dien.
Beyrichites Khanikoffi Oppel.
,, *Kesava* Dien.
,, *proximus* Oppel.
Cuccoceras Yoga Dien.
Japonites cf. Dieneri Mart.
Protrachyceras Cautleyi Dien.
,, *cf. longobardicum* Mojs.
Isculites Hauerinus Stol.
Acrochordiceras cf. Carolinæ Mojs.
,, *Balarama* Dien.
,, *sp. ind. aff. pusterico* Mojs.

Monophyllites sphærophyllus Hauer.
Sturia Sansovinii Mojs.
Pinacoceras Rajah Dien.
Buddhaites Rama Dien.
Gymnites Jollyanus Opp.
  „ *incultus* Beyr.
  „ *cf. Humboldti* Mojs.
  „ *Mandiva* Dien.
  „ *Kirata* Dien.
  „ *Sankara* Dien.
  „ *sp. ind. aff. Sankara.*
  „ *religiosus* Dien.
  „ *sp. ind. aff. religioso.*
  „ *sp. ind. aff. subclauso* Hauer.
Anagymnites cf. acutus Hauer.
  „ *Torrensii* Dien.
Ptychites rugifer Opp.
  „ *cf. cognatus* Opp.
  „ *Sumitra* Dien.
  „ *Durandii* Dien.
  „ *Everesti* Dien.
  „ *cf. Vidura* Dien.
  „ *Mahendra* Dien.
Joannites cf. proavus Dien.
  „ *sp. ind.*
Proarcestes sp. ind. aff. Bramantei Mojs.

In comparison with this long list the number of additions to the fauna of the upper Muschelkalk in the Niti area (Shalshal and Bambanag cliffs) is rather small. They include seven species of *Cephalopoda* altogether, namely :

Pleuronautilus sp. ind. aff. crassescens Arth.
Ceratites Roylesnus Dien.
  „ *(Halilucites) sp. ind. aff. planilaterato* Hau.
  „ *(Hollandites) Dungara* Dien.
  „ „ *Moorei* Dien.
  „ „ *Cecilii* Dien.
Ananorites monticola Dien.

The faunistic differences between the Spiti and Niti areas, which had appeared considerable before those new collections were made, have now proved to be much less important. The number of species peculiar to one of those two areas is comparatively small and will probably be reduced still more considerably by future researches. There is indeed a very close resemblance between the Muschelkalk faunas of both districts.

Numerically the Ceratites play the most important part in the Himálayan upper Muschelkalk, being represented by ten sub-genera and 41 species, while the genera *Ptychites*, *Gymnites* and *Beyrichites* are also remarkably rich in forms. The number of species indicating very close faunistic relations with the Alpine

Muschelkalk has also increased considerably. In 1905 three species common to the Alpine and Himálayan Muschelkalk were known to me:

Orthoceras campanile Mojs.
Sturia Sansovinii Mojs.
Proarcestes Balfouri Opp.

To this list must be added *Germanonautilus cf. salinarius* Mojs., *Ceratites trinodosus* Mojs., which is connected with *C. Thuilleri* Oppel by intermediate forms, a species of *Japonites*, which is perhaps identical with *J. Dieneri* Mart., a species of *Joannites*, referable probably to *J. proavus* Dien. from the Schiechlinghoehe near Hallstatt, *Acrochordiceras cf. Carolinæ* Mojs., *Monophyllites sphærophyllus* Hauer, *Gymnites incultus* Beyr., *Gymnites cf. Humboldti* Mojs. *Anagymnites cf. acutus* Hauer.

This faunistic affinity is corroborated by the presence of three identical species of *Brachiopoda*, all of them representing very common and widespread types of the Alpine Muschelkalk, *viz.* :—

Cœnothyris vulgaris Schloth.
Mentzelia Mentzelii Dunk.
Spiriferina Koeveskalliensis Suess.

On the other hand the affinities to the Triassic faunæ of the Arctic-Pacific region have been proved to be less close than had been anticipated in 1895. They are chiefly indicated by the occurrence of *Beyrichites affinis* Mojs., a Siberian species, in the upper Muschelkalk of the Shalshal cliff. The affinity of the Indian sub-genus *Hollandites* to the group of *Ceratites polaris* is considered doubtful by Philippi. There is a close relationship between the Indian *Ptychites* of the group of *rugiferi* and the congeneric forms from Spitzbergen. The Indian species of *Japonites* are less nearly allied to *Japonites planiplicatus* Mojs. from Japan than to the European types of this genus recently discovered in the Trias of the South-Eastern Alps.

Eight genera or sub-genera appear in Hayden's and A. v. Krafft's recent collections, which had as yet not been noticed in the upper Muschelkalk of the Himálayas. They are as follows:

Monophyllites Mojs.
Pinacoceras Mojs.
Joannites Mojs.
Cuccoceras Dien.
Halilucites Dien.
Haydenites Dien.
Salterites Dien.
Ananorites Dien.

With the exception of the three last-mentioned sub-genera of *Ceratites* and of *Ananorites* they are represented by species exhibiting a near affinity to well-known types of the Alpine Muschelkalk.

Mistaken.
Hollandites is as
common in Nevada
as in India.
Haydenites also occurs
in Nevada. J. P. Smith

The number of faunistic elements peculiar to the Indian Triassic province, has not been altered considerably by my recent studies. To these elements belong the group of *Ptychites Gerardi* Blfd. and *Pt. Malletianus* Stol., the genera *Buddhaites* and *Smithoceras*, the sub-genera *Pseudodanubites*, *Haydenites*, *Salterites*, and the majority of the *Ceratites circumplicati* included in the sub-genus *Hollandites*.

Among Hayden's collections from Spiti several forms were recognised by A. v. Krafft as bearing a close resemblance to ladinic types, and it was accordingly suggested that the upper Muschelkalk included the ladinic stage, at that time unknown from any part of the central Himálayas. Later researches made by A. v. Krafft and Hayden have proved the ladinic stage to be well represented in Spiti. True passage-beds between the upper Muschelkalk and the Daonella shales, with *Daonella Lommeli*, of ladinic age have been discovered by Hayden in nearly all the Spiti sections (l. c. p. 75). The assertion that ladinic types occur already in the true Muschelkalk, might be supported by the presence of two forms of decidedly ladinic character, *Protrachyceras Cautleyi* Dien. and *Protrachyceras cf. longobardicum* Mojs. But their occurrence in the main mass of the upper Muschelkalk (group 4) is not beyond doubt, and it is more probable that they were collected in the younger passage-beds, in which ladinic and Muschelkalk types are associated. Unfortunately the mode of preservation of the specimens yields no clue.

A. v. Krafft was the first to draw attention to the uniform development of the Muschelkalk in Spiti, Garhwal and Kumaon, a uniformity, which goes so far, that almost every single bed found in the one area can be recognised in the other. It seems, however, that this uniformity does not extend into eastern Johar. According to the short notes left by the late A. v. Krafft, from which the following extracts have been made, in Byans, near the boundary of Nepal, the Muschelkalk is developed as a light grey limestone, without any trace of shaly partings. In his sketch of the Triassic series of Byans published in my description of the fauna of the Tropites limestone, A. v. Krafft states that the chocolate limestone of the lower Trias is overlain by a massive limestone about 250 feet in thickness, the topmost beds of which contain the rich fauna with *Tropites* described in Pt. 1 of the present volume. About 50 feet above the top of the chocolate limestone *Cephalopoda* of the upper Muschelkalk occur, underlain by a bed with *Brachiopoda* of lower Muschelkalk age. The limestones are pure, of a light grey colour, rather different from the dark limestone of the Muschelkalk in the north-western districts, and the shaly bands so common there are entirely absent in Byans. Owing to great disturbances in the rocks nearly everywhere, all the *Cephalopoda* are greatly deformed and elliptical in outline. Nothing definite can be said as to the thickness of the Muschelkalk, as no lithological demarcation is seen in the mass of limestone either below or above the fossiliferous beds.

Both the existence of the beds with *Rhynchonella Griesbachi* (group 1), of the lower Muschelkalk with *Spiriferina Stracheyi* (3) and of the upper Muschelkalk (4) have been proved by fossils.

In 1895 I was able to prove the existence of the upper Muschelkalk in Byans by the examination of fossils collected by C. L. Griesbach near Kalapani. The following species of *Cephalopoda* were known to me:—

Grypoceras Griesbachi Dien.
Ceratites Kuvera Dien.
Buddhaites Rama Dien.
Ptychites Sahadeva Dien.

Of these four species *Grypoceras Griesbachi* has been recently collected in the upper Muschelkalk of Kágá, Spiti, by Hayden. *Buddhaites Rama* is an important leading fossil of the Muschelkalk of Painkhanda. The two remaining species are nearly allied to types of Muschelkalk age.

Smith and A. v. Krafft have been able to add to this list of *Cephalopoda* a considerable number of species, which were collected chiefly near Jolinka, in the Kutiyangti valley. The following species have been determined:—

Atractites Smithii Dien.
Orthoceras cf. campanile Mojs.
Pleuronautilus sp. ind. aff. ornato Hau.
" *sp. ind. aff. Rallieri* Arth.
Mojsvaroceras sp. ind. aff. Morloti Mojs.
" *nivicola* Dien.
Ceratites Thuilleri Oppel.
" *Kuvera* Dien.
Ceratites (Philippites) Jolinkanus Dien.
" *(Hollandites) Vyasa* Dien.
" " *Roxburghii* Dien.
" *(Peripleurocyclus) Smithianus* Dien.
Smithoceras Drummondi Dien.
Sogeceras sp. ind.
Buddhaites Rama Dien.
Bukowskiites Colvini Dien.
Pinacoceras Loomisii Dien.
Gymnites Jollyanus Oppel.
" *Kirata* Dien.
" *Sankara* Dien.
Ptychites Sahadeva Dien.

This fauna decidedly shows the character of the upper Muschelkalk, but is remarkable for the admixture of several types which have not as yet been found in any Himálayan district outside Byans. The new genus *Bukowskiites* and the sub-genera *Philippites* and *Peripleurocyclus* of the Indian group of *Ceratites circumplicati* are among them.

Fossils of the lower Muschelkalk in this area were also first discovered by C. L. Griesbach. A specimen of *Dielasma himalayanum* from his collections from the Kuti river was described by Bittner in Vol. III of this series (l. c. p. 27).

Smith found the horizon of *Spiriferina Stracheyi* (3) in the sections of Kalapani and Jolinka, where it contains :—

Spiriferina Stracheyi Salt.
Spirigera Stoliczkai Bittn.
Dielasma himalayanum Bittn.

That the bed with *Rhynchonella Griesbachi* of disputed age is not absent in Byans, has been proved by the presence of numerous examples of this characteristic species in Smith's collections from Kalapani. The matrix is the same light grey limestone, of which the fossils from the bed of *Spiriferina Stracheyi* are composed, and differs strongly from the chocolate limestone of the lower Trias. From the same locality two specimens of *Rhynchonella trinodosi* Bittn., one of the most characteristic species of the Alpine Muschelkalk, are known to me. It is, of course, impossible to fix their exact layer in the Muschelkalk of Byans, the labels attached to the specimens yielding no information.

This eastern facies of the Muschelkalk does not seem to extend beyond the watershed between the Dhauli Ganga and Kali river valleys. In the ridge between the Dharma and Lissar valleys the Muschelkalk is developed as a dark shaly limestone, as in Painkhanda and Spiti. Numerous fossils of lower and upper Muschelkalk age have been found in the collections of T. D. LaTouche from this locality. The following is a list of *Cephalopoda* of upper Muschelkalk age :—

Grypoceras sp. ind. ex aff. G. Palladii Mojs.
Ceratites Thuilleri Opp.
Ceratites (Hollandites) Ravana Dien.
" " *Airavata* Dien.
" " *Dungara* Dien.
Beyrichites cf. Rudra Dien.
Pseudodanubites cf. Dritarashtra Dien.
Acrochordiceras cf. Carolinæ Mojs.
" *Balarama* Dien.
" *sp. ind. aff. pusterico* Mojs.
Gymnites Jollyanus Opp.
" *Sankara* Dien.

The presence of the lower Muschelkalk is proved by the occurrence of *Spiriferina Stracheyi* and *Dielasma himalayanum.*

Our knowledge of the Muschelkalk of Kashmir is very meagre. The presence of a fauna of this age is, however, proved by a small number of ammonites described in my memoir in Pt. 2, Vol. II, of this series.

In a letter written shortly before his death A. v. Krafft has drawn my attention to the fact that the Muschelkalk fauna known from Kashmir is not confined to *Ceratites Thuilleri* Oppel, as stated by me (l. c. p. 98). To this species from Sunamarg (coll. Lydekker) the following three must be added :—

Gymnites Salteri Beyr. from Ladakh, exact locality unknown.

Proarcestes Balfouri Oppel, from Drás, coll. Schlagintweit. The label attached to the type-specimen by Oppel gives the locality as "Dras (?) Hundes, locality somewhat doubtful." A. v. Krafft thinks that the locality actually meant is Dras in the Kashmir basin, some 50 or 60 miles to the east-north-east of Srinagar.

Ptychites nov sp. ind. ex aff. Malletiano Stol. (*Ptychites Durandii* Dien.). The locality on the label accompanying this specimen was given as "north of Padam, Spiti." A. v. Krafft tells me, that he has never heard of a place of that or of a similar name in Spiti, but that there is a village of that name in Kashmir (Zanskar valley). About ten miles north of this village Trias is marked on Lydekker's map.

Lydekker further mentions *Ptychites Gerardi* Blfd. from Tajwaz (Sind valley), Stoliczka quotes "*Gymnites Batteni*" from the Para valley, but these determinations are scarcely reliable.

As to the lower Muschelkalk we may suppose from Stoliczka's mention of *Spiriferina Stracheyi* from the Tsarap valley (Zanskar basin), that beds of this age occur there.

The number of *Cephalopoda* of the Muschelkalk (anisic stage) in the main region of the Himálayas has now increased to 148 species, including 41 genera and sub-genera. To the order of *Ammonoidea* 127 species belong. The following genera and sub-genera are represented in this fauna :—

Atractites Gnemb. (2 species.)
Orthoceras Breyn. (4 sp.)
Pleuronautilus Mojs. (3 sp.)
Mojsvaroceras Hyatt. (4 sp.)
Thuringionautilus Mojs. (1 sp.)
Germanonautilus Mojs. (1 sp.)
Syringonautilus Mojs. (1 sp.)
Grypoceras Hyatt (3 sp.)
Paranautilus Mojs. (2 sp.)
Ceratites de Haan (section of *nodosi* Beyr.) (11 sp.)
Philippites Dien. (2 sp.)
Gymnotoceras Hyatt (2 sp.)
Halilucites Dien. (1 sp.)
Hollandites Dien. (15 sp.)
Peripleurocyclus Dien. (1 sp.)
Salterites Dien. (1 sp.)
Haydenites Dien. (1 sp.)
Keyserlingites Hyatt. (7 sp.)
Florianites Hyatt. (1 sp.)
Beyrichites Waagen. (1 sp.)
Cuccoceras Dien. (1 sp.)
Japonites Mojs. (5 sp.)
Bukowskiites Dien. (1 sp.)
Pseudodanubites Hyatt. (1 sp.)

Stacheites Kittl. (1 sp.)
Dalmatites Kittl. (1 sp.)
Isculites Mojs. (1 sp.)
Smithoceras Dien. (1 sp.)
Acrochordiceras Hyatt. (4 sp.)
Sibirites Mojs. (1 sp.)
Sageceras Mojs. (1 sp.)
Ananorites Dien. (1 sp.)
Monophyllites Mojs. (5 sp.)
Sturia Mojs. (1 sp.)
Gymnites Mojs. (13 sp.)
Anagymnites Hyatt. (3 sp.)
Buddhaites Dien. (1 sp.)
Ptychites Mojs. (19 sp.)
Pinacoceras Mojs. (2 sp.)
Proarcestes Mojs. (3 sp.)
Joannites Mojs. (2 sp.)

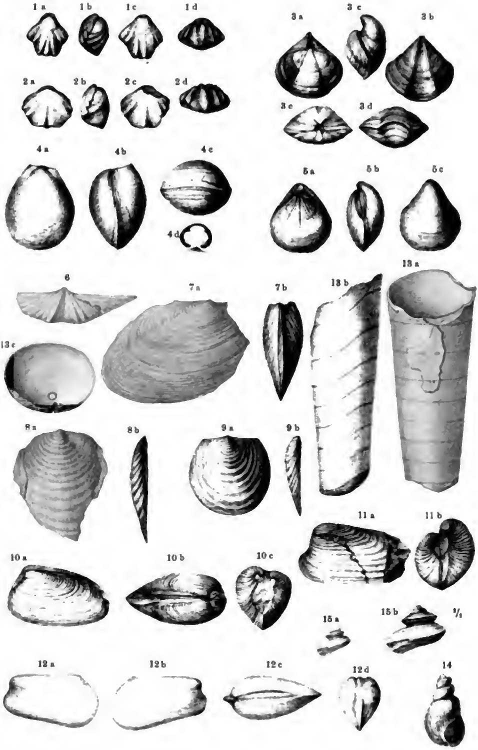
Protrachyceras Cautleyi Dien., *Protrachyceras cf. longobardicum* Mojs., *Ceratites Wetsoni* Oppel, *Ceratites onustus* Oppel and *Lobites Oldhamianus* Stol., which are *incertæ sedis*, have been excluded from this list.

In number of species and genera the fauna of the Himálayan Muschelkalk is no longer inferior to that of this stage in the Alps.

PLATE I.

Fig 1a, b, c, d Rhynchonella trinodosi Bittn. Kalapani, coll. Smith.
" 2a, b, c, d " " " " " "
" 3a, b, c, d, e Spiriferina (Mentzelia) Mentzelii Dunk. N. W. of Muth, coll. Krafft.
" 4a, b, c, d }
" 5a, b, c } Cœnothyris vulgaris Schloth. Kágá, coll. Hayden.
" 6 Spiriferina Stracheyi Stol., var. alata. Lower Muschelkalk, Lilang, coll. Krafft.
" 7a, b, Posidonomya nov. sp. ind. aff. pannonica Mojs. Muth, coll. Hayden.
" 8a, b }
" 9a, b } Posidonomya cf. bosniaca Bittn. Ridge between Dharma and Lissar valleys, coll. La Touche.
" 10a, b, c }
" 11a, b } Cardiomorpha Haydeni Dien. Muth, coll. Hayden.
" 12a, b, c, d Pleurophorus sp. ind. Lower Muschelkalk, Lilang, coll. Krafft.
" 13a, b Atractites Smithi Dien. Jolinka, Byans, coll. Smith.
" 14 Pseudomelania sp. ind. Muth, coll. Smith.
" 15a, b (b twice enlarged) Tectospira gracilis Bl. Muth, coll Krafft.

Fauna of the Himâlayan Muschelkalk.



Swoboda del. Jaffé phot.

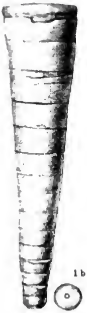
Kunstanstalt Max Jaffé, Wien.

PLATE II.

FIG. 1*a*, *b* ORTHOCERAS SPITIENSE Dien. Muth, coll. Hayden.
„ 2 „ cf. MULTILABIATUM v. Hauer. Shalshal Cliff, beds with *Spiriferina Stracheyi*, coll. Krafft.
„ 3*a*, *b*, *c* THURINGIONAUTILUS SP. IND. Kágá, coll. Hayden.
„ 4*a*, *b* PLEURONAUTILUS SP. IND. AFF. ORNATO Hauer. Jolinka, Byans, coll. Smith.
„ 5*a*, *b* „ „ „ ROLLIERI Arth. Jolinka, Byans, coll. Smith.
„ 6*a*, *b* MOJSVAROCERAS NIVICOLA Dien. Jolinka, coll. Smith.
„ 7*a*, *b* „ SP. AFF. MORLOTI Mojs. Jolinka, coll. Smith.
„ 8*a*, *b* „ KAGÆ Dien. Kágá, coll. Hayden.
„ 9*a*, *b* „ SP. IND. AFF. KAGÆ Dien. Muth, coll. Hayden.

Fauna of the Himálayan Muschelkalk.

Geol. Surv. of India. Pl. II.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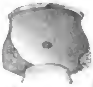
1 b

2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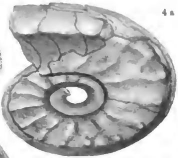
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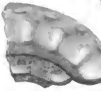
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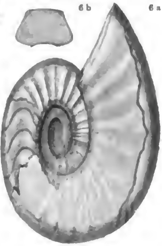
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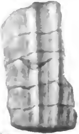
6 a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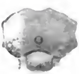
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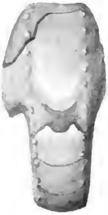
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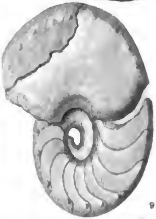
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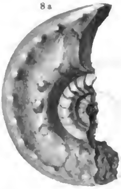
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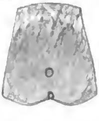
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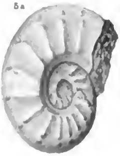
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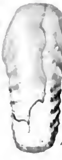
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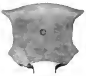
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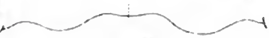
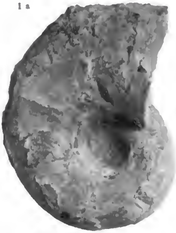

9 b

Swoboda del. Jaffe phot. Kunstanstalt Max Jaffe, Wien.

PLATE III.

Fig. 1*a*, *b*	Germanonautilus cf. salinarius Mojs. Chambered part of a full-grown specimen; Muth, coll. Hayden.
„ 2*a*, *b*	Paranautilus Bullockii Dien. Muth, coll. Hayden.
„ 3*a*, *b*	Pleuronautilus sp. ind. ex. aff. crassescens Arth. Shalshal Cliff, coll. Krafft.
„ 4*a*, *b*	Ceratites superbiformis Dien. Muth, coll. Hayden. 7.50
„ 5*a*, *b*	„ trinodosus Mojs. N. N. W. of Kágá, coll. Hayden.
„ 6*a*, *b*	„ (Hollandites) Cecilii Dien. Kágá, coll. Hayden.
„ 7	Cuccoceras Yoga Dien. Body-chamber. Muth, coll. Hayden.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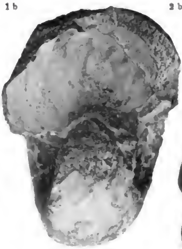
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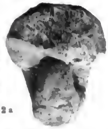
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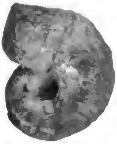
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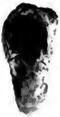
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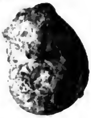
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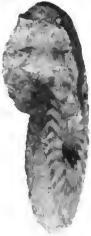
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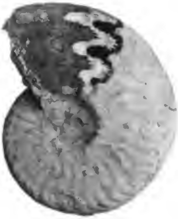
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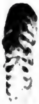
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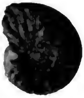
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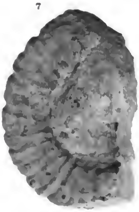
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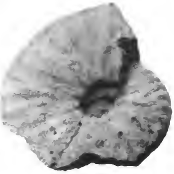
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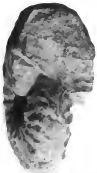
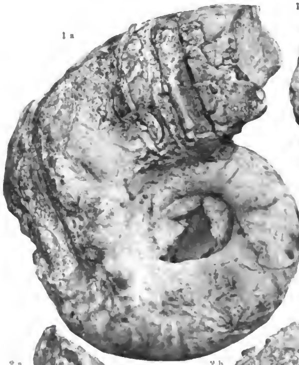

5 b

Phot. Hugo Hinterberger.
Kunstanstalt Max Jaffé, Wien

PLATE XI.

Fig. 1a, b Keyserlingites Dieneri Mojs. Lower Muschelkalk, Shalshal Cliff, coll. Krafft.
„ 2a, b, c, d „ „ „ „ „ Lilang, coll. Krafft.
„ 3a, b „ sp. ind. aff. Bukozi Mojs. Lower Muschelkalk, Lilang, coll. Krafft.
„ 4 „ nov. sp. ind. Lower Muschelkalk, Lilang, coll. Krafft.
„ 5a, b Worthenia dharmaensis Blaschke. Between Dharma and Lissar Valleys, coll. La Touche.
„ 6 Promathildia (?) sp. ind. Muth, coll. Krafft.
„ 7a, b Omphaloptycha Smithii Blaschke. Jolinka, coll. Smith.
„ 8 „ sp. ind. Kágá, coll. Krafft.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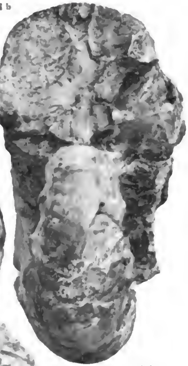
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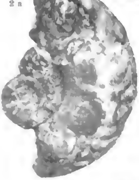
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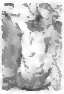
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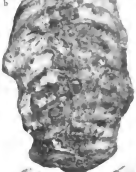
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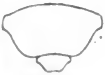
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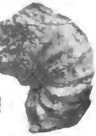
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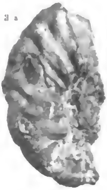
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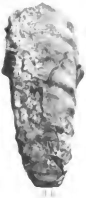
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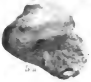
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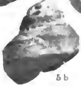
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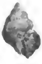
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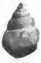
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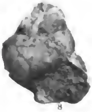
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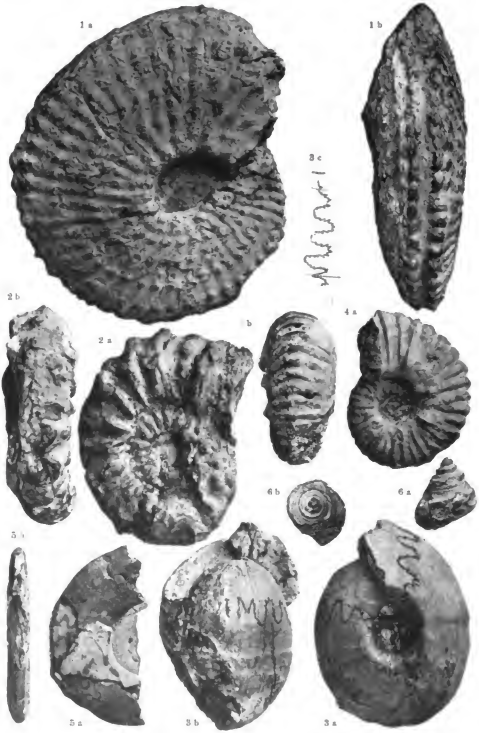
Phot. u. Lichtdruck v. Max Jaffé, Wien.

PLATE XII.

Fig. 1*a*, *b* PROTRACHYCERAS cf. LONGOBARDICUM Mojs. N. N. W. of Kágá, coll. Hayden. 7.95
„ 2*a*, *b* „ CAUTLEYI Diener. N. N. W. of Kágá, coll. Hayden. 7.95
The occurrence of these two specimens in the Upper Muschelkalk is doubtful.
„ 3*a*, *b*, *c* SMITHOCERAS DRUMMONDI Diener. Jolinka, Byans, coll. Smith.
„ 4*a*, *b* ACROCHORDICERAS cf. CAROLINÆ Mojs. Muth, coll. Hayden.
„ 5*a*, *b* ANANORITES MONTICOLA Dien. Bambanag Cliff, coll. Krafft.
„ 6*a*, *b* WORTHENIA DIENERI Blaschke. Kágá, coll. Hayden.



Phot. u. Lichtdruck v. Max Jaffé. Wien

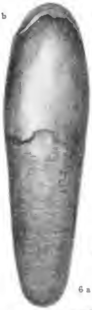
PLATE XIII.

Fig. 1*a*, *b* Pleurotomaria indica Blaschke. Muth, Spiti, coll. Hayden. 1*b*, twice enlarged.
„ 2 „ sp. ind. Kágá, coll. Krafft.
„ 3 Gen. ind. sp. ind. Muth, coll. Krafft.
„ 4 Worthenia sp. ind. aff. Dharmaensis Blaschke. Lower Muschelkalk, Lilang, coll. Krafft.
„ 5*a*, *b* Monophyllites Kingi Dien. Lower Muschelkalk, Lilang, coll. Krafft.
„ 6*a*, *b* „ Hara Dien. Lower Muschelkalk, Bambanag Cliff, coll. Krafft.
„ 7 „ „ Dien. Sutures of a specimen from the same locality.
„ 8*a*, *b* „ „ Dien. var. Lower Muschelkalk, Shalshal Cliff, coll. Krafft.
„ 9 „ Pradyumna Dien. Lower Muschelkalk, Lilang, coll. Krafft.
„ 10*a*, *b* „ cf. Confucii Dien. Lower Muschelkalk, W of Lilang, coll. Krafft.
„ 11 „ cf. sphærophyllus Hauer (Sutures). Kágá, coll. Krafft
„ 12*a*, *b* Ptychites Durandii Dien. Muth, coll. Hayden.

Fauna of the Himálayan Muschelkalk.

Geol. Surv. of India. Pl. XIII.

5 b



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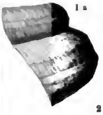
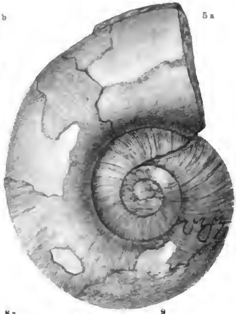


1 b

5 a



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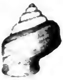

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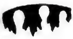

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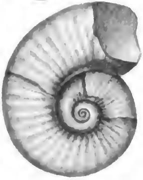

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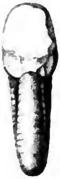

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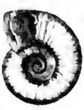

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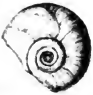

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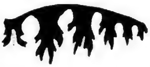
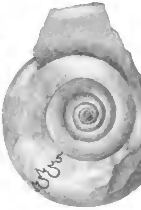


4

10 a

10 b



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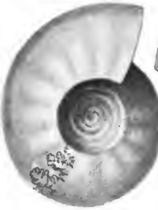
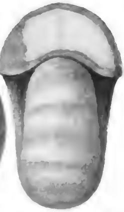


12 b



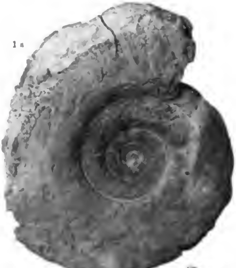
Swoboda del. Jaffé phot.

Kunstanstalt Max Jaffé, Wien

PLATE XIV.

Fig. 1a, b GYMNITES INCULTUS Beyr. N. N. W. of Muth, coll. Hayden.
„ 2a, b „ „ Beyr. Transverse section and sutures of a large specimen.
„ 3a, b „ cf. HUMBOLDTI Mojs. Transverse section and sutures of a large specimen Muth, coll. Hayden.
„ 4a, b „ DEPAUPERATUS Dien. Lower Muschelkalk, Lilang, coll. Krafft.
„ 5 JOANNITES SP. IND. N. N. W. of Kágá, coll. Hayden.

1 a



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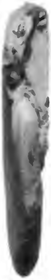

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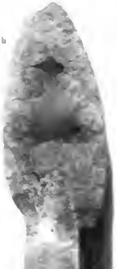

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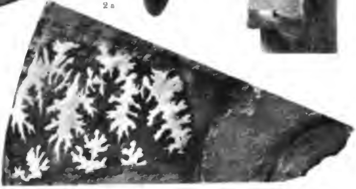

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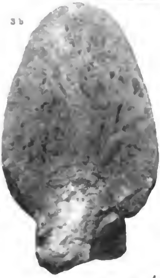

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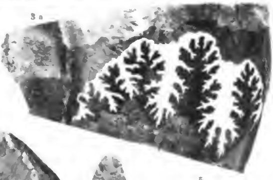

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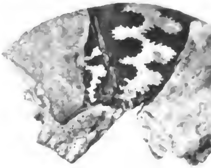

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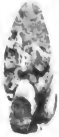

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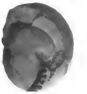
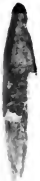


Phot. Hugo Hinterberger. Kunstanstalt Max Jaffé, Wien.

PLATE XVII.

Fig. 1
,, 2*a*, *b* } PINACOCERAS LOOMISII Dien. Jolinka, Byans, coll. Smith.
,, 3*a*, *b*
,, 4*a*, *b*, *c* BUKOWSKIITES COLVINI Dien Jolinka, Byans, coll. Smith.
,, 5*a*, *b* JOANNITES cf. PROAVUS Dien. N. N. W. of Kágá, coll. Hayden.

3 b



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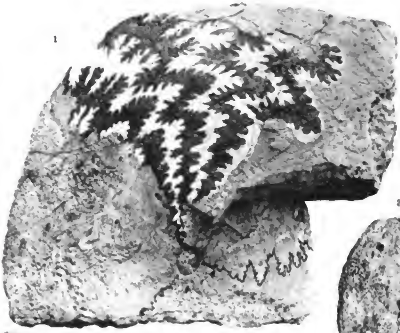

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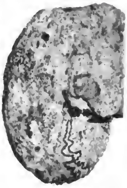

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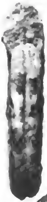

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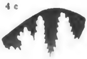

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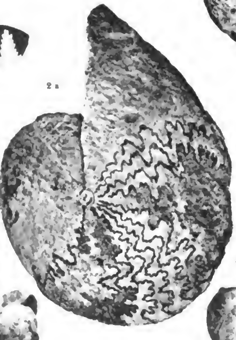

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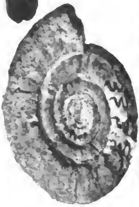

5 a

5 b

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